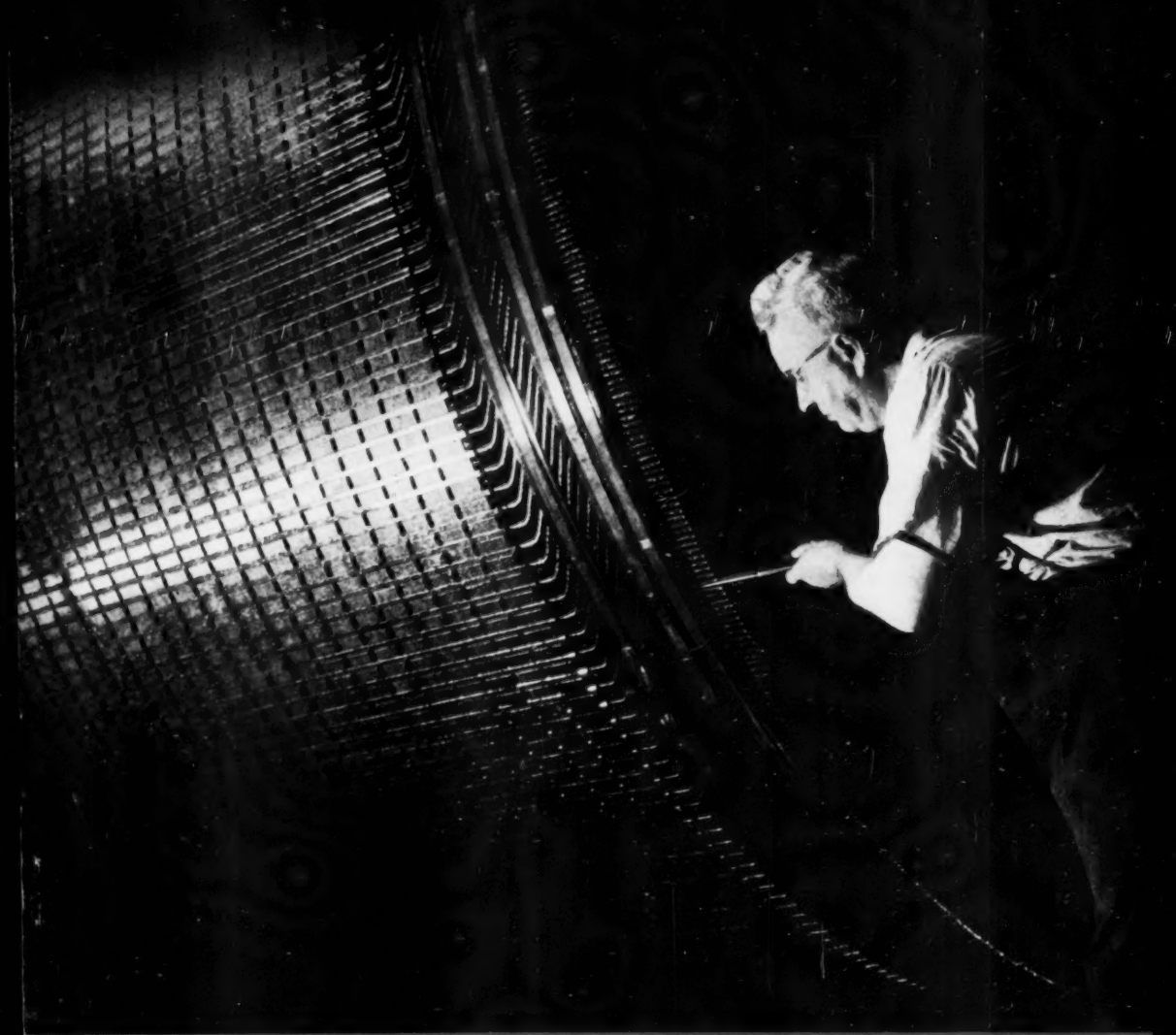
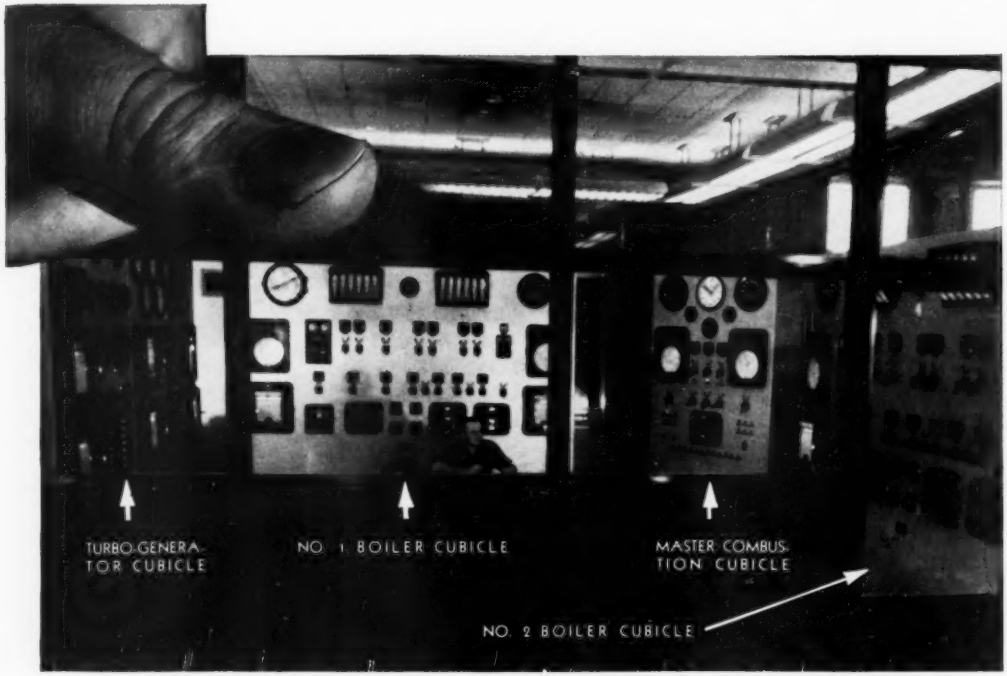
POWER

JULY 1949

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES



IN THIS ISSUE: Largest oil-burning diesel plant goes into operation at Mexico City — for details of design see p 72; fundamentals of smoke-density indication and control, p 78; arc welding plus imagination halves maintenance costs, p 81; exclusive report on current status of the atomic-energy program, p 90. **CONTENTS, p 67**



THESE L&N CUBICLES
PUT STATION OPERATION "UNDER ONE THUMB"

Control-wise, the outstanding feature of Warren Station of Pennsylvania Electric Co. is that it demonstrates the coordinated, "under one thumb" regulation of boiler, turbine and generator. A single operator, stationed in a central control room, has undivided responsibility for every step, from putting coal into the furnace at one "end" of the plant to turning out kilowatts at the other "end." Gone are telephone conversations between boiler room and electric control room operators—gone is divided responsibility.

PENELEC engineers secured the control equipment for this efficient operation in a highly efficient way. They turned over the whole job of designing control cubicles to Leeds & Northrup specialists. We can handle this work effectively, because we make key instruments for so many processes—Metermax Combustion Control; Micromax Superheat Control; Micromax Recorders for temperature, CO_2, conductivity and other conditions.

Drawing on our years of experience in power instrument layout, we proceeded to design PENELEC's cubicles from the ground up to meet their particular needs. Instruments and controllers, switches, stop-start stations, signals and alarms were arranged for correct sequential operation. Each cubicle was detailed on complete drawings showing steel work, internal piping and actual final wiring.

Before leaving the L&N plant, each cubicle was completely assembled and then tested as a unit. When the equipment reached Warren, every connection to every instrument, controller, switch and signal was in place. To be ready for use, the group of cubicles needed only to be set in position and connected to electric control drives, primary elements and station power supply. The user saved much time, trouble and expense for his own engineering staff, and has the advantages of an entirely factory-assembled cubicle.

We'll be glad to send information about L&N instruments, controllers, and panels or cubicles. Write to Leeds & Northrup Company, 4910 Stenton Ave., Philadelphia 44, Pa.

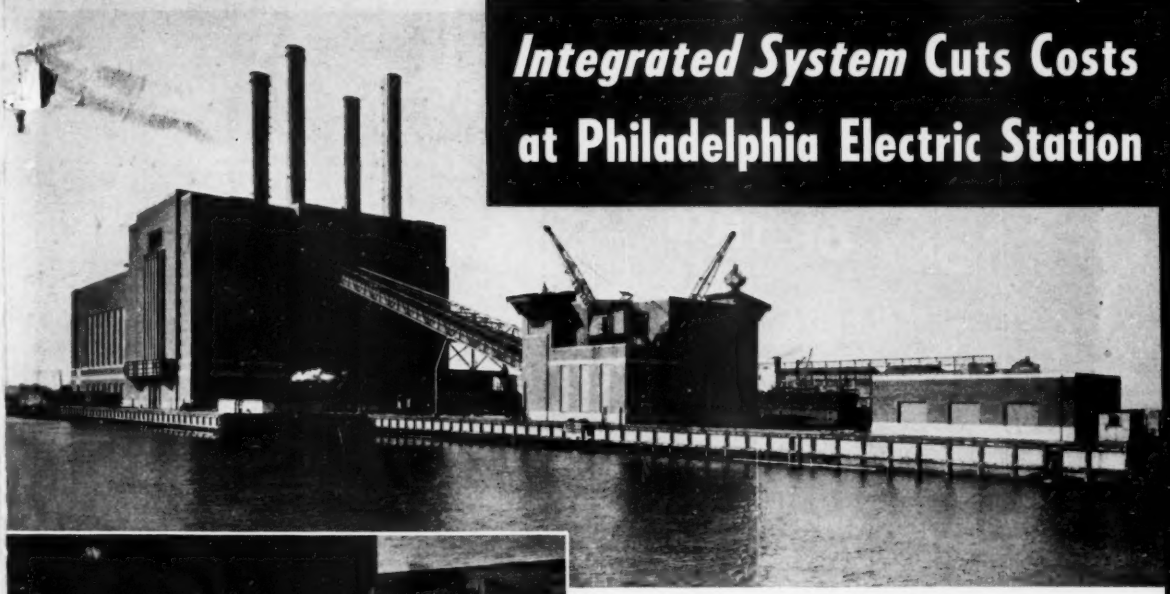
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

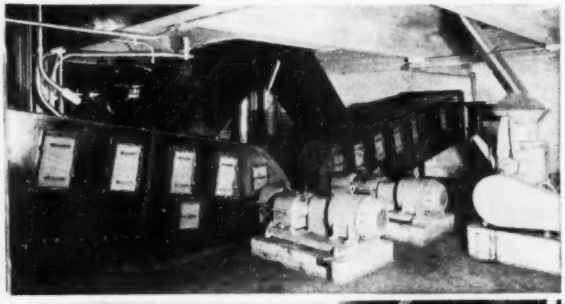
Jrl. Ad N-460(2)

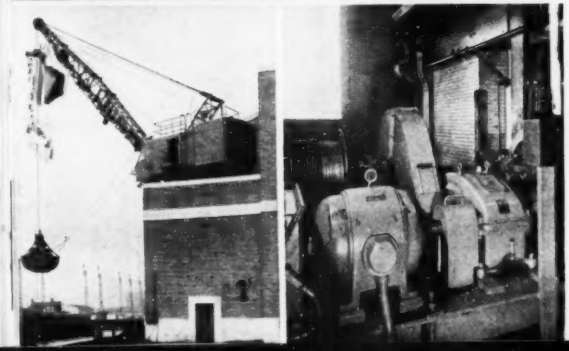
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer"), July, 1949, Vol. 93, No. 7. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $7 for two years, 50c per copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

Integrated System Cuts Costs at Philadelphia Electric Station



Above: Belt conveyor delivering coal to storage bunker. In center: Foot-end of belt conveyors showing speed reducer drives. Below: left—Link-Belt Speeder crane; right—Link-Belt barge shifting equipment.





Duplicate LINK-BELT Equipment handles 700 tons of coal per hour . . . . . .

The new Southwark Generating Station of Philadelphia Electric Company is another example of high efficiency, high capacity, and flexibility in handling coal — through planned integration of Link-Belt built and installed equipment.

Coal handling equipment from barges to storage bunkers is in duplicate, permitting river barges to be unloaded from each side of the pier simultaneously. Unloading is done by two Link-Belt Speeder hydraulically controlled cranes with 4-ton capacity clamshell buckets.

From the bottom of each 55-ton unloading hopper the coal passes to a short inclined steel apron feeder which discharges to a Bradford breaker. The 1 ½ " minus coal from the breakers passes to the main belt conveyors, from these to a system of belt conveyors by which the coal is weighed and delivered to the bunkers. An emergency system for receiving coal from R.R. cars is also provided.

For complete details of this and other Link-Belt handling systems get in touch with our nearest office.

LINK-BELT COMPANY

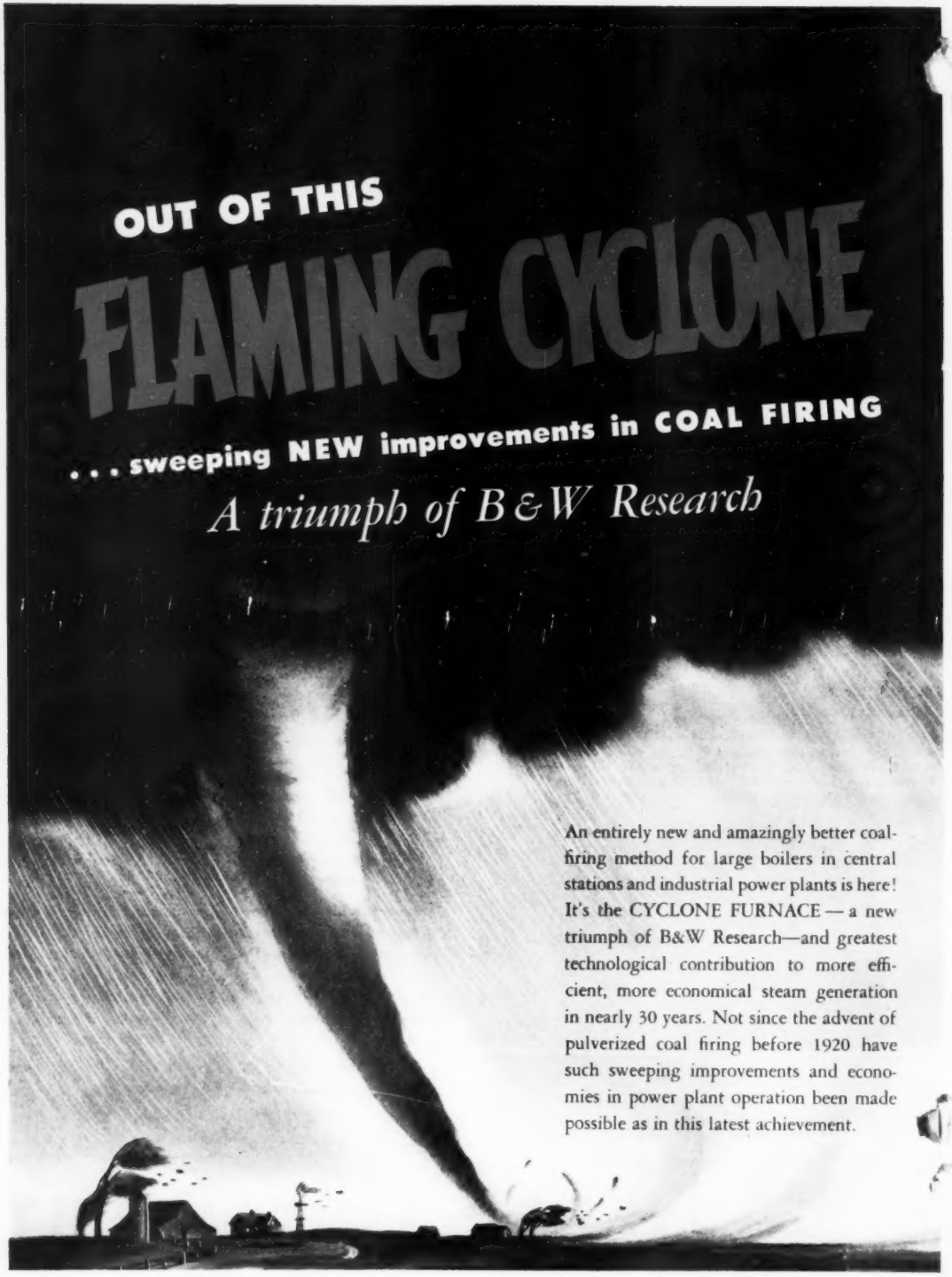
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 3, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

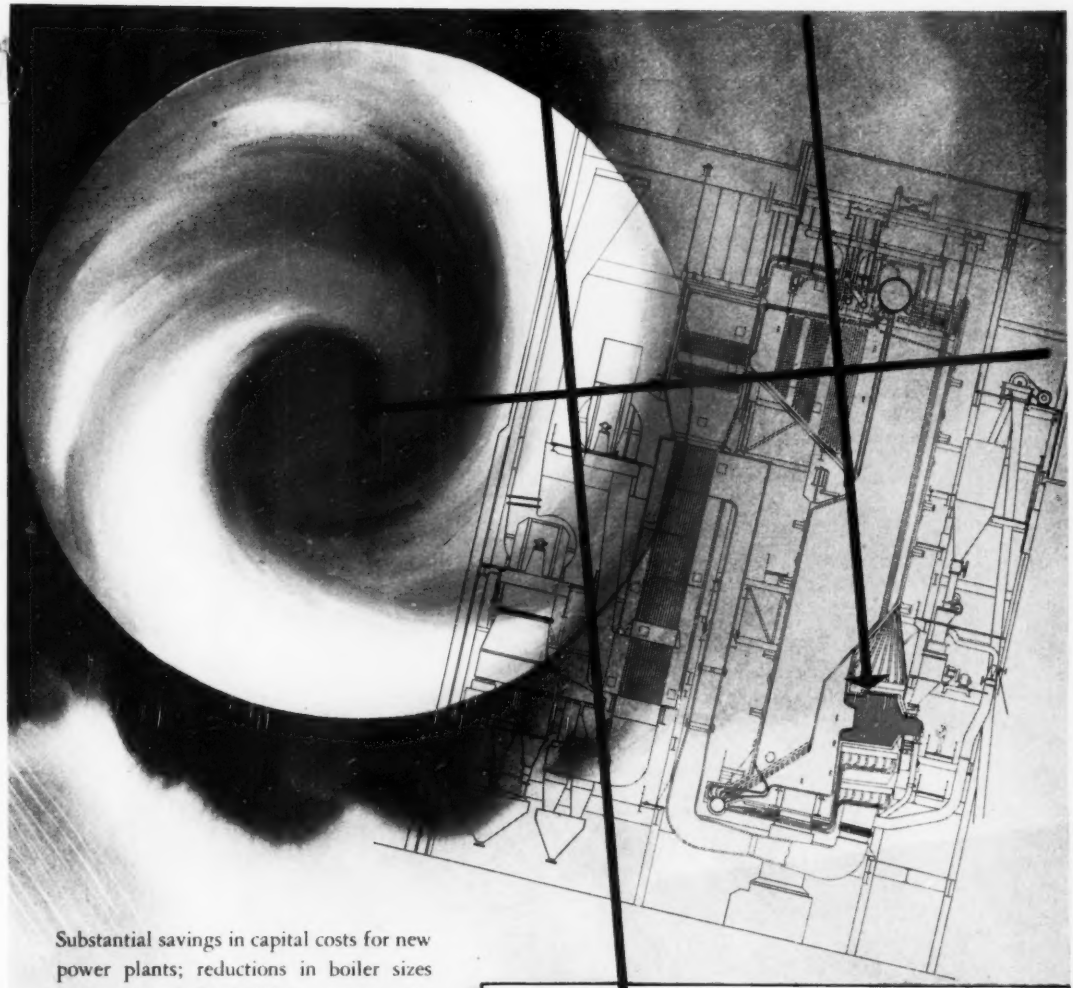
11.851

LINK-BELT

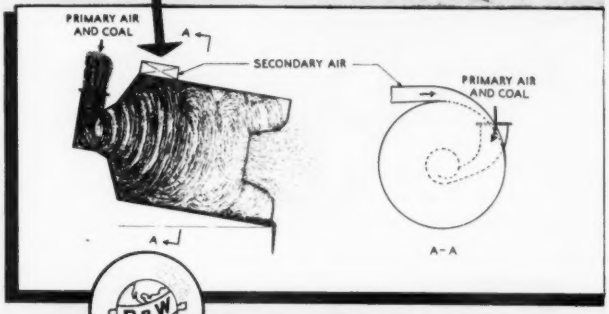
CONVEYING MACHINERY

"THE COMPLETE LINE"


OUT OF THIS
FLAMING CYCLONE
. . . sweeping NEW improvements in COAL FIRING
A triumph of B&W Research
An entirely new and amazingly better coal-firing method for large boilers in central stations and industrial power plants is here! It's the CYCLONE FURNACE — a new triumph of B&W Research—and greatest technological contribution to more efficient, more economical steam generation in nearly 30 years. Not since the advent of pulverized coal firing before 1920 have such sweeping improvements and economies in power plant operation been made possible as in this latest achievement.



Substantial savings in capital costs for new power plants; reductions in boiler sizes and weights, and in building requirements; simplified ash handling; much less stack dust; elimination of large auxiliaries; less boiler maintenance . . . these are among the outstanding benefits in the wake of this revolutionary firing method. Thoroughly tried and tested for several years in actual service, the Cyclone Furnace has confirmed all advance claims with results that exceeded expectations.

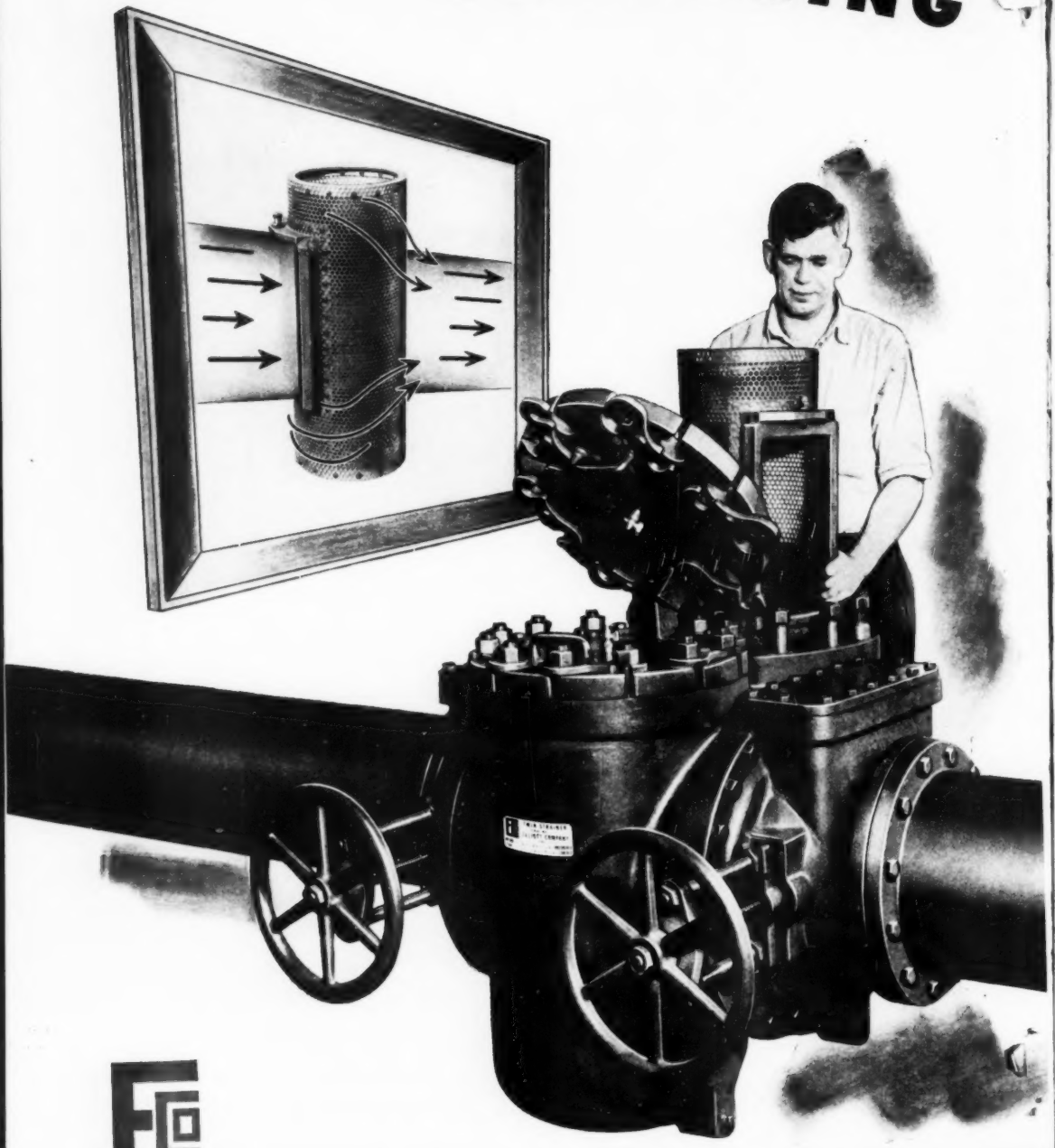


B&W

BABCOCK & WILCOX

G-353T

SOMETHING



ELLIOTT COMPANY

New IN STRAINERS

- **Streamline flow —**
  Low pressure drop.
- **Greater relative basket capacity (approximately 5 to 1 ratio with standard mesh) —**
  Less resistance to flow, longer time between cleaning.
- **Stronger, heavier baskets —**
  Long, enduring service.
- **Quick-visible valve position indicator —**
  Tells at a glance which basket is operating.
- **Strong steel doors —**
  Crack-proof, and lighter.
- **Easily removable valve disc —**
  To replace valve disc ring without dismantling valve.
- **Protected valve screw —**
  Threads in valve screw never touched by liquid.

Type A Twin Strainers have all the above new features, plus all the previous advantages which have for years made Twin Strainers standard for continuous straining service in power, process and marine applications.

Elliott Twin Strainers are built in sizes 1″ to 24″ for 125 lb. pressure and 1″ to 12″ for 250 lb. pressure. New bulletin on request. Mail the coupon.

Accessories Department
JEANNETTE, PA.
Plants in: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

A-297P

ELLIOTT COMPANY
Accessories Dept. — Jeannette, Pa.

Please send me Twin Strainer Bulletin A-13.

Name .....

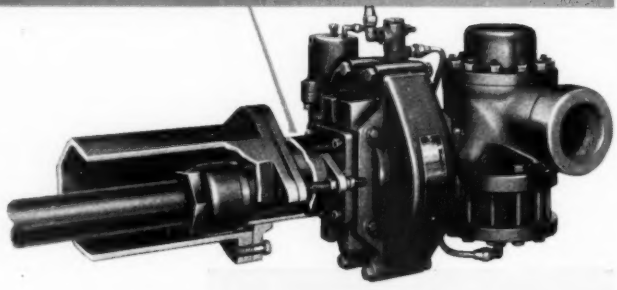
Company .....

Address ..... *City* ..... *State* .....

JUST OPEN ONE VALVE •

the Entire Boiler is CLEANED CORRECTLY

BY DIAMOND AUTOMATIC "AIR PUFF" SOOT BLOWERS



Correct cleaning *every time* is assured when you have Diamond Automatic "Air Puff" Soot Blowers.

Just a "twist of the wrist" to open one valve and the Master Controller does the rest. Each soot blower is operated correctly in its predetermined sequence. The operation continues until the entire blowing cycle is finished. Then the Master Controller shuts off automatically.

Diamond "Air Puff" Soot Blower elements are permanently installed in the setting. Compressed air is discharged from multiple nozzles in a series of short puffs with pauses between. During each puff, the element is automatically rotated through a small arc; there are sufficient puffs to sweep the surfaces to be cleaned.

The greater density of compressed air as compared to steam provides better cleaning. By discharging the air in puffs with pauses between, the cleaning cycle is spread over a longer period that permits use of a much smaller compressor and receiver. The automatic operation eliminates the human element—boilers *can't* be cleaned incorrectly.

Ask for Catalog No. 1014 for complete information about Diamond Soot Blowers.

OTHER ADVANTAGES

SAVES LABOR—No attendant needed to drain piping, warm up and operate each individual blowing unit.

SAVES FUEL—Uses only ⅓ to ⅔ of energy from coal pile needed for steam blowing.

NO FEED WATER MAKEUP

STACK DISCHARGE NUISANCE MINIMIZED—Intermittent operation expels soot in small quantities.

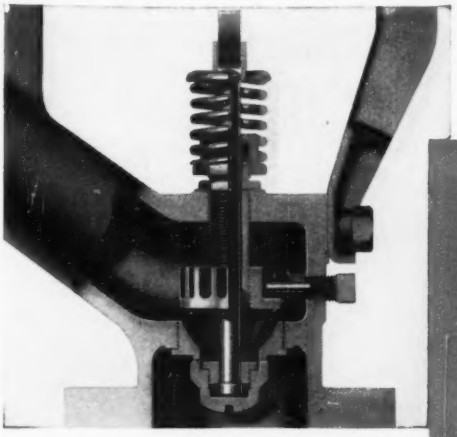
REDUCED MAINTENANCE

PIPING INSULATION ELIMINATED

3538

DIAMOND POWER SPECIALTY CORP.
DETROIT 31, MICHIGAN
Diamond Specialty Limited • Windsor, Ontario

Adjustable Pressure Control



one reason

why more

DIAMOND G9B SOOT BLOWERS

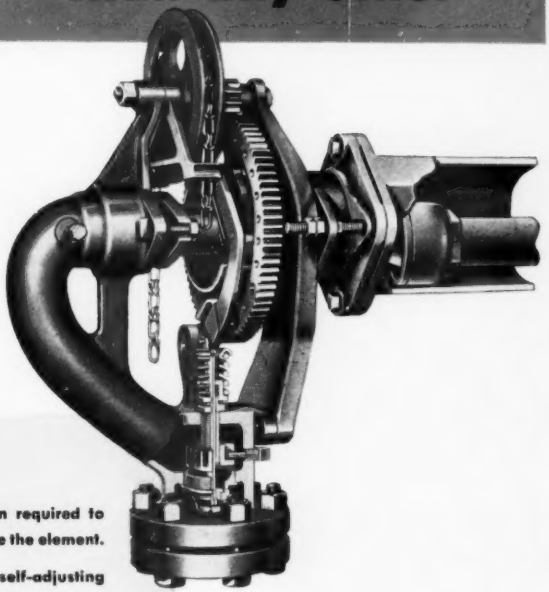
are in use than any other

Diamond Integral Adjustable Pressure Control is a simple, effective device used where the steam pressure is higher than needed for good soot blowing but not so extreme as to require a reducing valve.

It consists of a pressure control disc carried on the threaded valve stem guide. By removing the plug shown, the ribs on the upper part of the disc can be engaged by a screw driver. Moving the ribs screws the disc up or down, widening or narrowing the opening and increasing or decreasing the effective pressure. A gauge can be installed at the top of the gooseneck to check pressure setting.

Individual G9B units can be made automatic any time after installation by simply adding a drive to existing equipment. Then, all blowers on the boiler can be made automatic sequential in operation by addition of a control panel. Write for Catalog No. 1014 for further information.

3704



other advantages

Automatic Valved Head . . . only one operation required to open and close the valve and simultaneously rotate the element.

Flexible Element Connection . . . makes element self-adjusting for movement of boiler tubes.

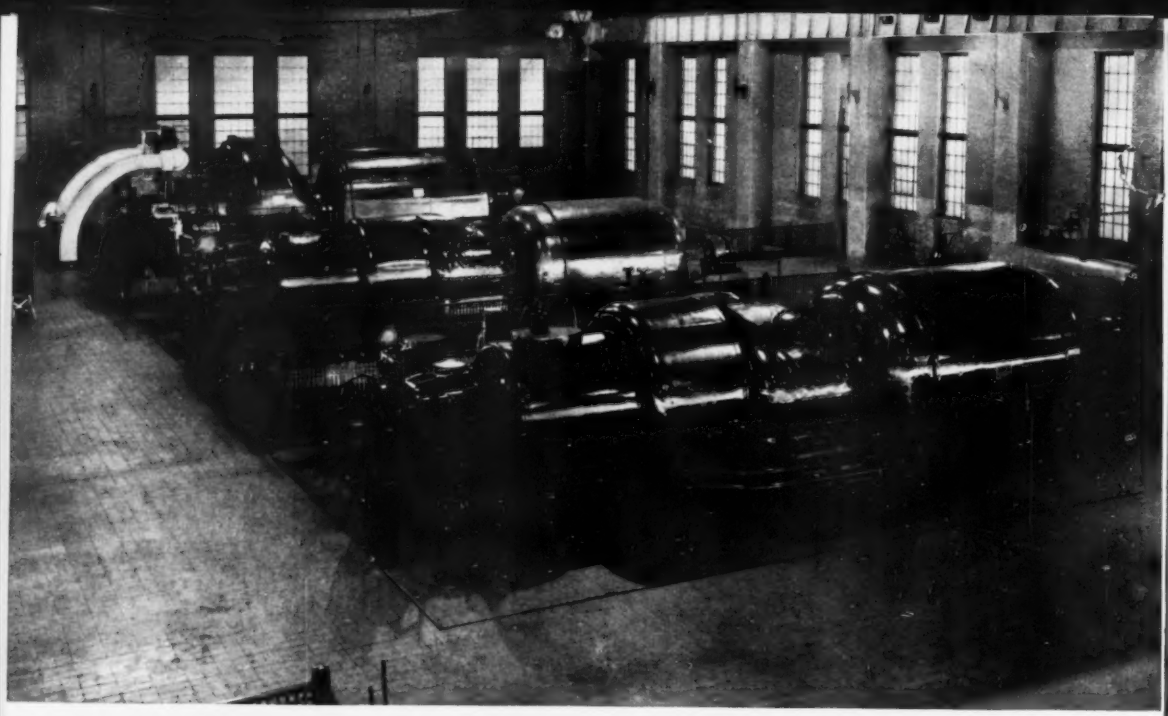
Poppet Type Valve . . . experience proves it to be the best type of unlubricated valve for rugged work.

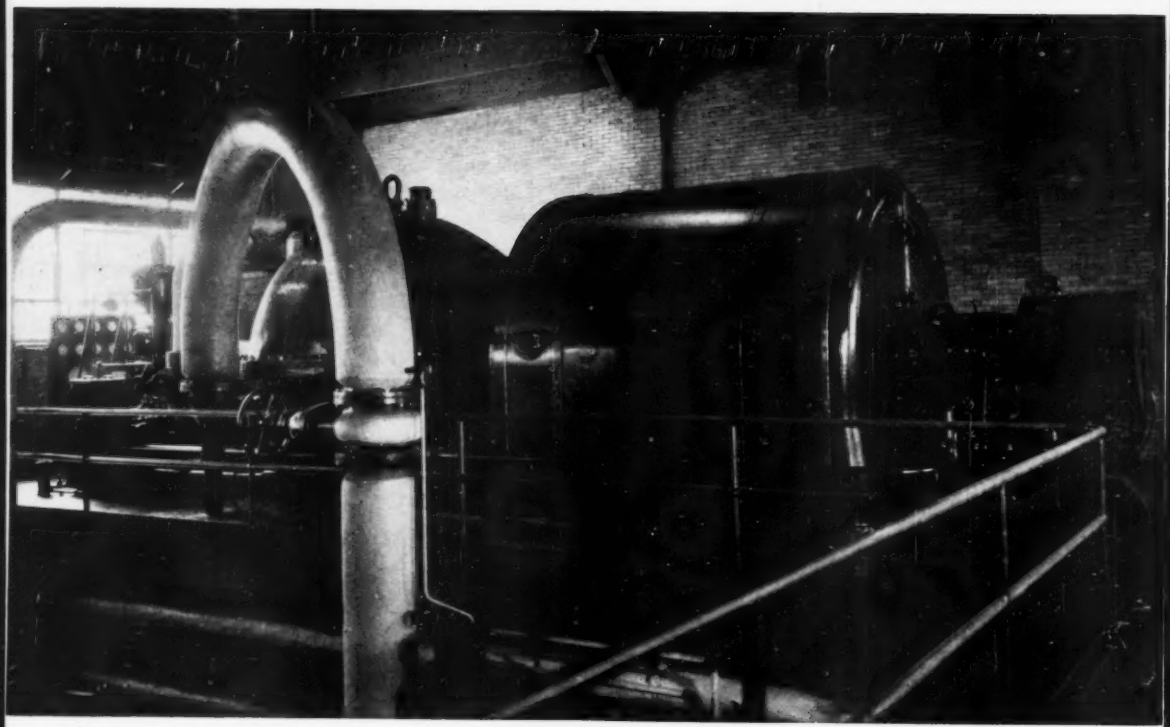
Cam and Trigger Valve Operation—Clockwise or Counterclockwise Element Rotation.

DIAMOND POWER SPECIALTY CORPORATION

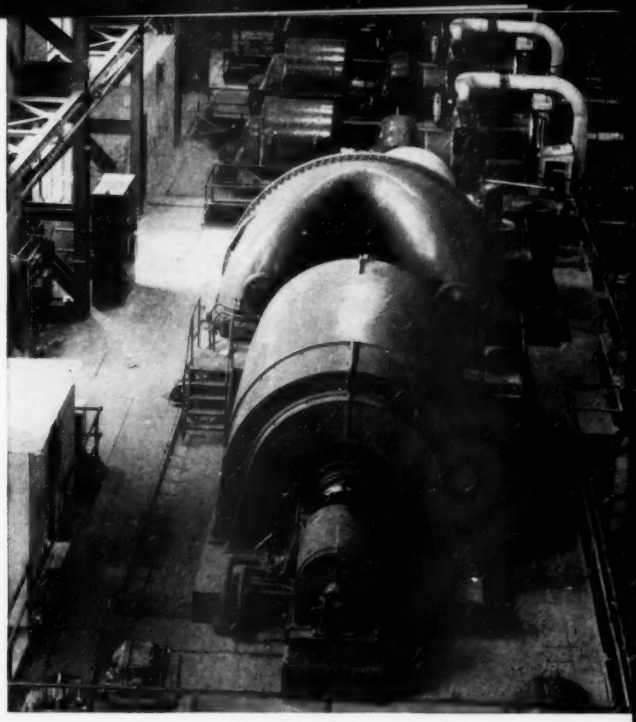
Detroit 31, Michigan

DIAMOND SPECIALTY LIMITED
WINDSOR, ONTARIO





STANDARD OIL COMPANY (INDIANA)



21-year record shows economy of...

NONPAREIL Turbine Oil

"Will outlast your turbine"

WHEN A LARGE COMPANY uses one turbine oil for over 21 years and in an increasing number of units, it's worth knowing why!

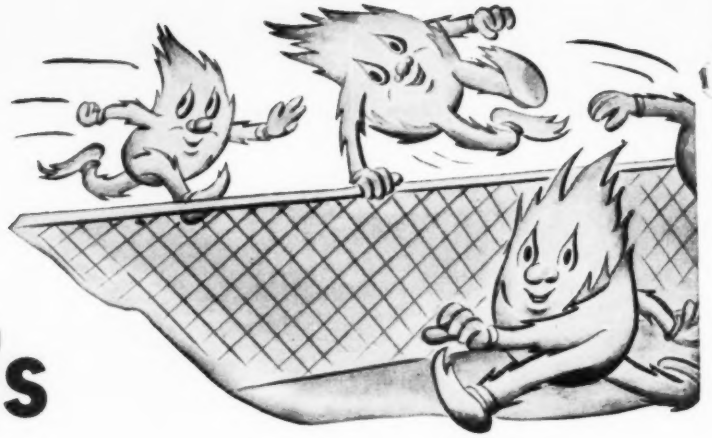
In 1927, the Carnegie-Illinois Steel Corporation put Nonpareil Turbine Oil into a 30,000 KW General Electric turbine. Today, this company lubricates sixteen turbines, having a total capacity of nearly 200,000 KW, with Nonpareil. What's back of the impressive acceptance of this turbine oil?

Here's the 21-year record for the company's first Nonpareil-lubricated turbine: *No oil replaced, no oil removed for treating, no need to clean the oil system.*

Such economical and reliable turbine lubrication has kept Carnegie-Illinois Steel officials completely sold on Nonpareil. Why not make their experience your basis for investigating Nonpareil's advantages? A Standard Oil Lubrication Engineer will supply you with information about utility operations on which Nonpareil has reduced lubrication costs as much as 68%.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD



Btu's

Every fuel has a large percentage of Btu's ready to "go over the fence". They do no work. They produce no power. The more you can keep on the job—the lower your power costs will be. And that is exactly what the Bailey co-ordinated boiler control system can do for you.

It reduces fuel consumption per pound of steam generated. Combustion, feed water, steam temperature, heater levels, pump speeds and all other factors are co-ordinated—automatically controlled. With Bailey Controls safety of operation is increased—continuity of service is improved. You convert the maximum number of Btu's into power. You get full efficiency from your boiler.

Many Bailey co-ordinated boiler control systems have paid for themselves in fuel saved in less than one year. All do not return their original cost as quickly as this. But the quick way to find out how Bailey boiler control will work for you is to talk to one of our engineers. Bailey co-ordinated boiler control is not a package unit. Each must be engineered to the specific job.

If you are looking for low cost power, it will pay you to call our nearest office.

A-105-1

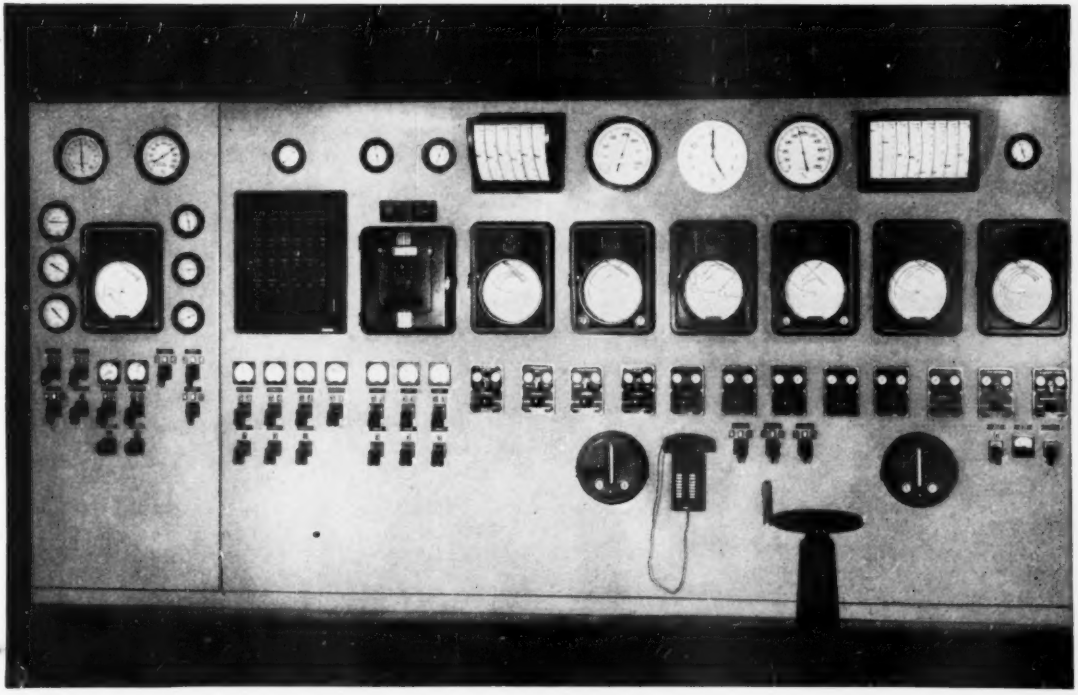
BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

BAILEY METERS

Controls for Steam Plants
COMBUSTION • FEED WATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

Branches In: Boston, New York, Schenectady, Philadelphia, Buffalo, Pittsburgh, Charlotte, Cleveland, Detroit, Cincinnati, Atlanta,

Go a.w.o.l.

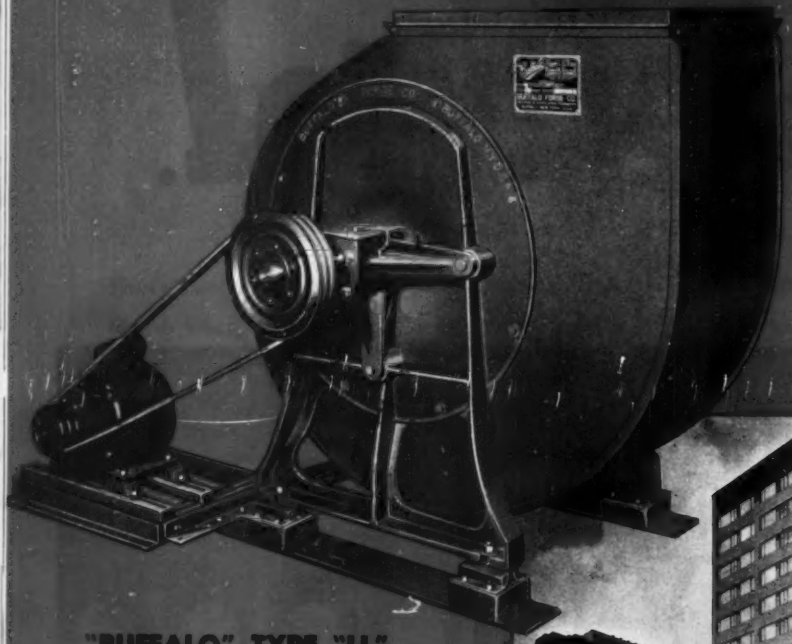


This co-ordinated system of Bailey Combustion and Three-element Feed Water Control prevents Btu's from going a.w.o.l. at Potomac Edison Company, Williamsport, Maryland. The maximum steaming capacity of this 860 psi pulverized coal fired boiler is 400,000 lbs. per hour.

Chicago, Milwaukee, St. Louis, New Orleans, St. Paul, Kansas City, Houston, Denver, Los Angeles, Seattle, San Francisco

Air of Hospitality

HOSPITALITY: "Act of Receiving and Entertaining Strangers or Guests Generously and Kindly."
— Webster



"BUFFALO" TYPE "LL" VENTILATING FAN WITH SILENT, FLOATING BASE

Air Conditioning by Carrier Corp.

THE TERRACE PLAZA illustrates the highest concepts in the design of the mid-century hotel building. 19 stories high, it incorporates both stores and complete hotel facilities. 81 "Buffalo" Fans provide the unfailing, efficient circulation of this "Air of Hospitality".

Air Conditioning Installed by Associated Mechanical Contractors — Houston.

THE SHAMROCK, $20,000,000 Landmark to Hospitality, was started on St. Patrick's Day, 1946, and opened three years later to the day. A dream realized by the famous Glenn McCarthy, it is the "last word" in artistic beauty, comfort and convenience. "Buffalo" Limit-Load Fans, Belted Vent Sets and Breezo Fans help supply its vital "Air of Hospitality".

"BUFFALO" FANS CIRCULATE "AIR OF HOSPITALITY" FOR THESE ULTRA-MODERN HOTEL BUILDINGS

SHOWN here are two of the country's finest examples of hospitality — The Shamrock in Houston and the Terrace Plaza Hotel in Cincinnati. Both leave nothing to be desired for the comfort and enjoyment of guests. The choice of fans in both was "Buffalo" — for quiet, economical air delivery, day and night. For new or existing buildings, don't neglect the many benefits of "Buffalo" ventilation. YOUR "BUFFALO" REPRESENTATIVE WILL BE GLAD TO GIVE YOU ALL THE FACTS.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities

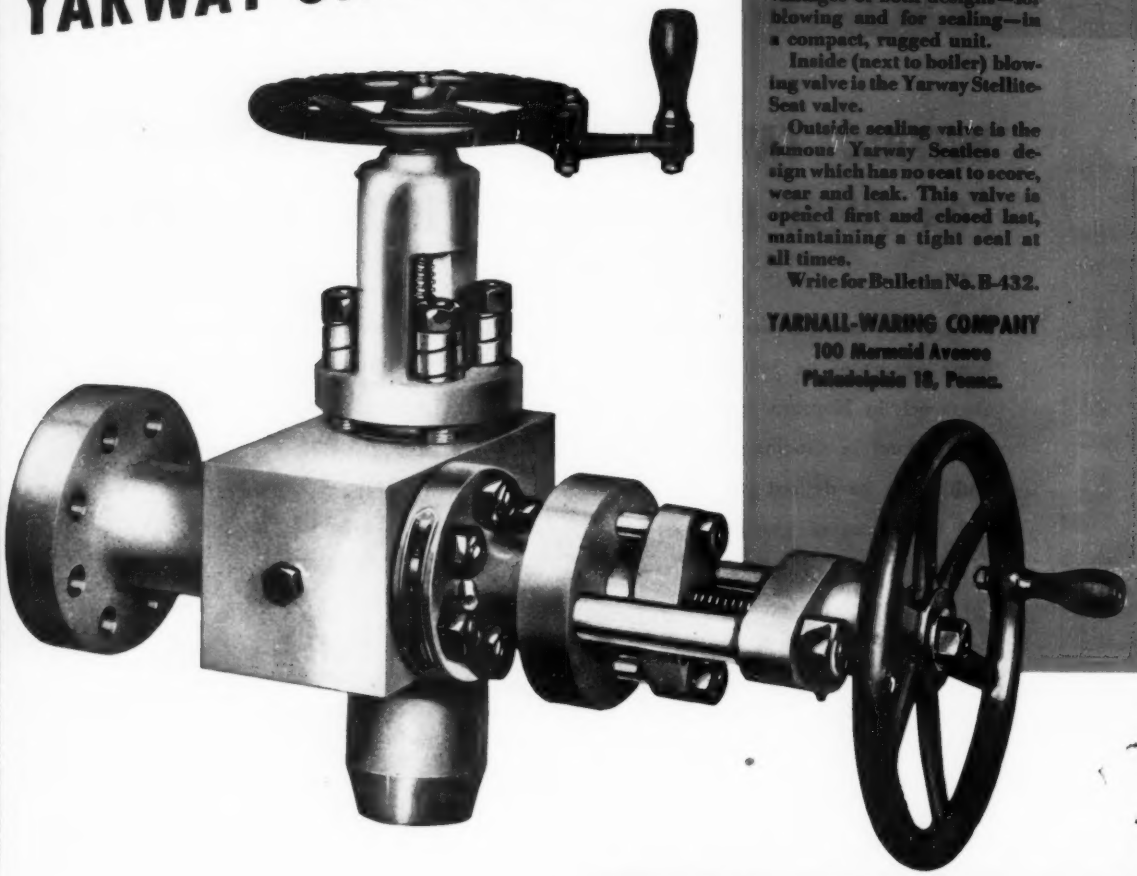
"Buffalo"

First for Fans And Air Conditioning

HIGHER P

Call For

YARWAY UNIT TANDEMS



Years of service in the high pressure plants of leading Utilities and Industrials have proved the soundness of design and metallurgy of Yarway Unit Tandems.

Yarway Unit Tandems are built for pressures up to 2500 psi. Combining a Stellite-Seat and a Seatless valve in a single one-piece forged steel body, this tandem provides the advantages of both designs—for blowing and for sealing—in a compact, rugged unit.

Inside (next to boiler) blowing valve is the Yarway Stellite-Seat valve.

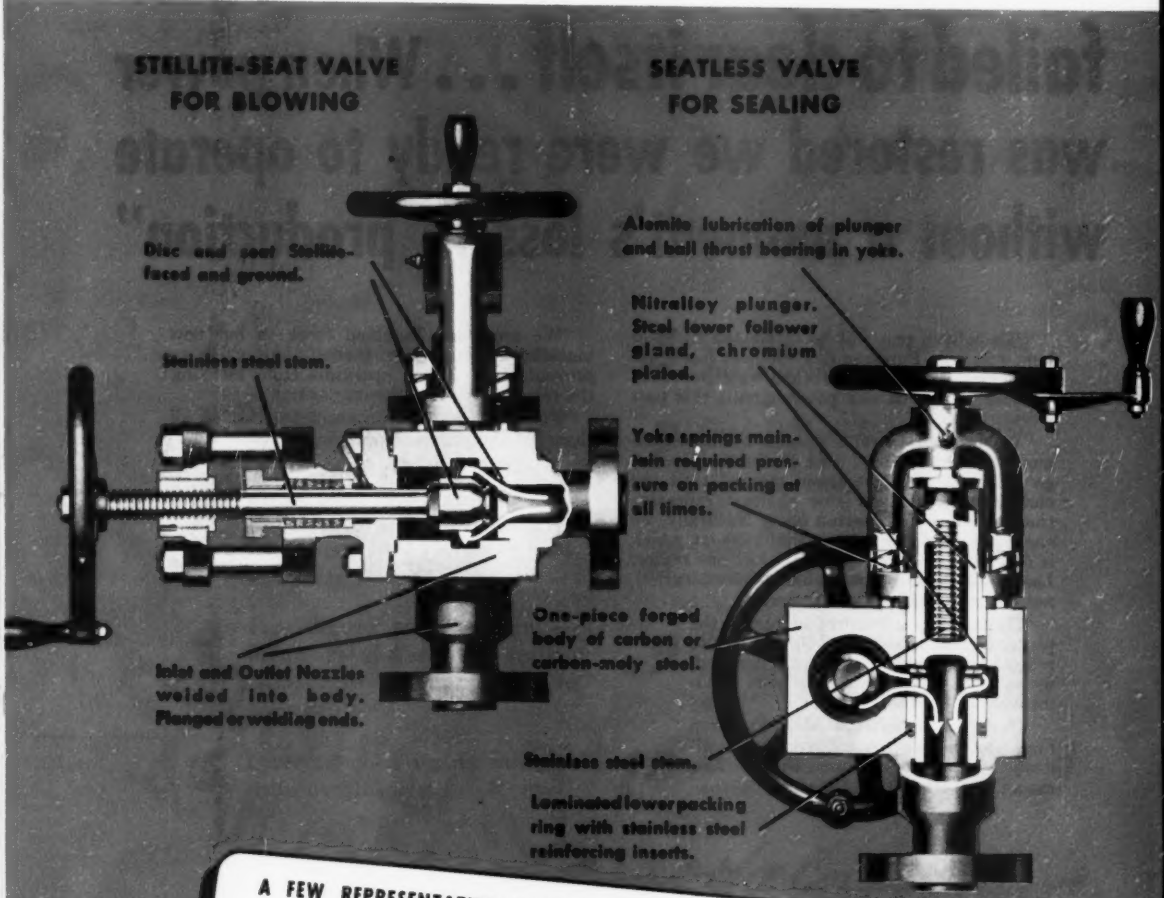
Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is opened first and closed last, maintaining a tight seal at all times.

Write for Bulletin No. B-432.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Penna.

YARWAY

RESSURES


STELLITE-SEAT VALVE
FOR BLOWING
SEATLESS VALVE
FOR SEALING
Disc and seat Stellite-faced and ground.
Stainless steel stem.
Inlet and Outlet Nozzles welded into body. Flanged or welding ends.
Alemite lubrication of plunger and ball thrust bearing in yoke.
Nitralloy plunger. Steel lower follower gland, chromium plated.
Yoke springs maintain required pressure on packing at all times.
One-piece forged body of carbon or carbon-moly steel.
Stainless steel stem.
Laminated lower packing ring with stainless steel reinforcing inserts.

A FEW REPRESENTATIVE USERS OF HIGH PRESSURE YARWAY BLOW-OFF VALVES

• UTILITIES •

Philadelphia Electric Co.
Boston Edison Co.
Pacific Gas & Electric Co.
Pennsylvania Power & Light Co
Georgia Power Co.
Cleveland Elec. Illuminating Co.
Connecticut Light & Power Co.
Indiana-Michigan Power Co.

• INDUSTRIAL PLANTS •

Celanese Corp.
R. J. Reynolds Tobacco Co.
Eastman Kodak Co.
Armour & Co.
American Viscose Co.
Lever Bros. Co.
Armstrong Cork Co.
Bethlehem Steel Co.

BLOW-OFF VALVES

"During a power phase failure not one motor out of over 100 failed to clear itself . . . When power was restored we were ready to operate without a moment's loss in production"

"We believe you will be interested to know how well your Fusetron dual-element fuses protected our electric motors when we experienced a phase failure on our power circuit this past week.

"We have considerable obsolete 2 phase equipment in our plant but we are eliminating it as we go along. To protect these motors until the change-over, we had two choices: expensive thermal relays or Fusetron fuses. Naturally, we chose Fusetron fuses. From that time on, which is over two years, we have not lost one motor. Last week when the power phase failure occurred, not one motor failed to clear itself.

"Having over a hundred motors in the plant, we had a hatfull of blown fuses to replace but, when the power was restored, we were ready to operate without a moment's loss in production.

"Our past experience with Fusetron fuses proves that they will not blow needlessly — provided, of course, that the fuse rating is matched to the motor.

"We are using Fusetron fuses on our new machinery along with thermal protectors to prevent the machine operators from blocking the relay switches in the on position.

"Fusetron fuses are an absolute must on all electrical equipment in our plant."

Victor J. Kryst, *Maintenance Foreman,*
F. H. HILL COMPANY, INC.,
Cleveland, Ohio

Our Experience . . . . . Proves

Facts About FUSETRON Dual-Element FUSES

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Fusetron DUAL-ELEMENT Fuses

Provide

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Get all the Facts - Send the Coupon Now!

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FUSETRON Dual-Element Fuses Give ALL-PURPOSE PROTECTION

One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON dual-element fuse in every set of fuse clips throughout the entire electrical system.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

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*City & Zone*_____ *State*_____ 749

KVS

AIR SWEPT TUBE MILLS

for BITUMINOUS...

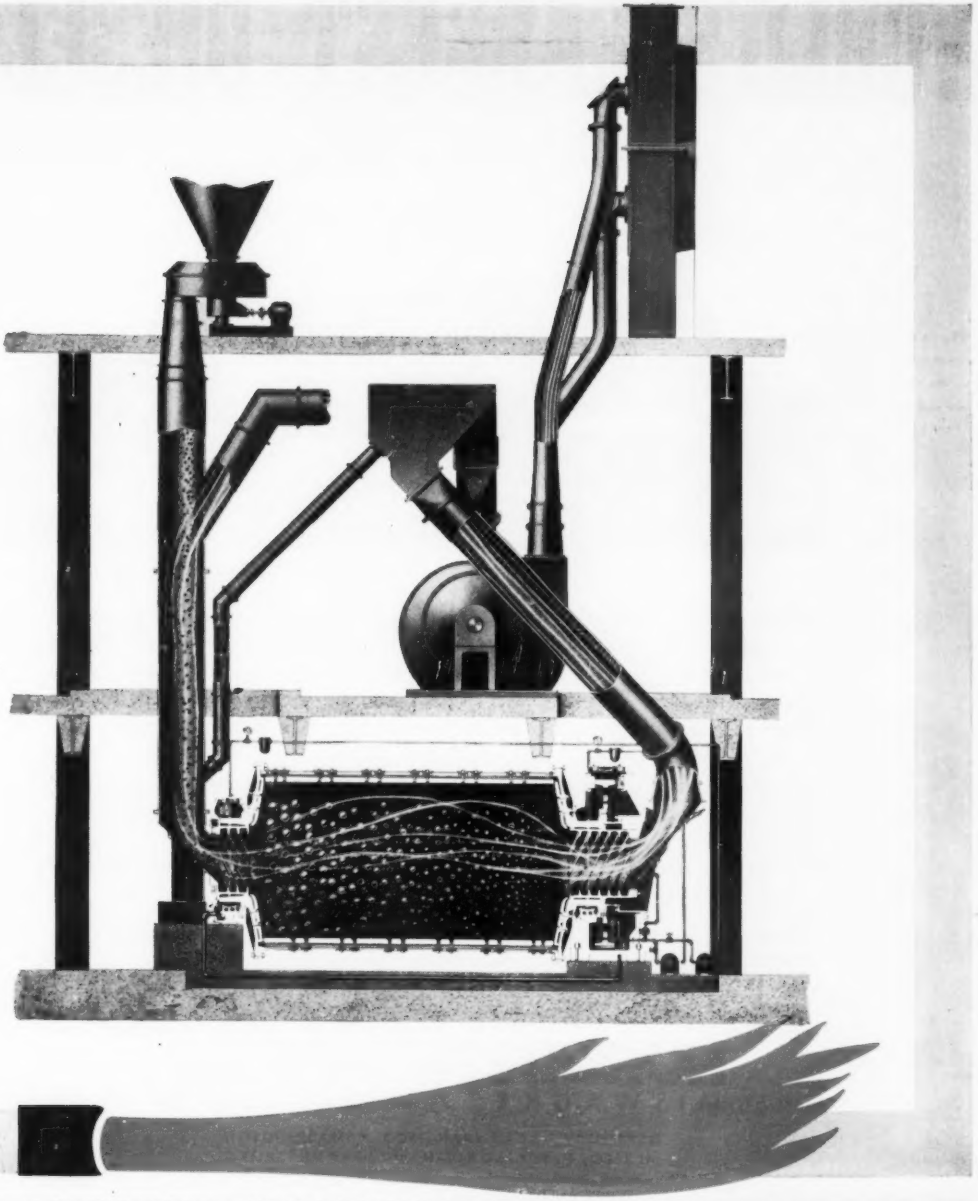
ANTHRACITE...COKE BREEZE

The KVS Air Swept Tube Mill, a slow speed ball mill, prepares all grades of coal for combustion at low power and maintenance costs. The pulverizing balls are carried by centrifugal force to a point where they are thrown down on the coal in a continuous cascade of balls delivering thousands of blows per second.

The KVS variable speed fan draws air through the mill, floating out an impalpable powder to deliver a carbureted fuel to the burners.

KVS offers a complete service in design, building and erecting complete steam generating plants under one responsibility. KVS engineers are available for consultation.

Ask for a copy of Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generation.



Kennedy Products
KENNEDY · CRAFTSMANSHIP · SERVICE · QUALITY
NEW YORK U.S.A.
MFG. & ENG. CORP.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

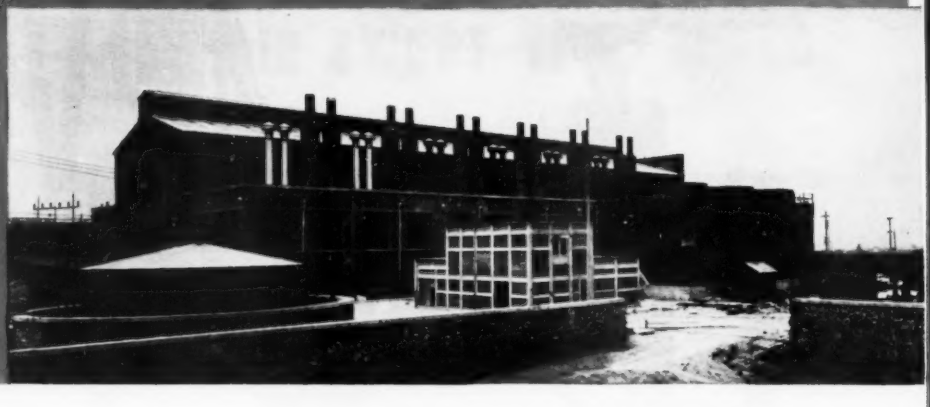
ARMY E NAVY

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

WORLD'S LARGEST DIESEL



The new Tacubaya generating station houses the six Nordberg Diesels and auxiliaries.

THE installation of six 8,650 horsepower engines in the new Tacubaya generating station in Mexico City establishes another record for Nordberg Diesels. In addition to being the world's largest Diesel powered public utility generating station, these engines are the largest ever built in the Western Hemisphere. These six engines have a total capacity of 51,900 H. P. at sea level or 44,400 H. P. at the installed elevation of 7,450 feet. This new plant, adding 30,000 K. W. for the power and lighting needs of Mexico City, was in service months sooner than was possible with any other type of power unit and is helping to alleviate a serious power shortage that had developed because of the increased demands for electric service.

Nordberg Diesels have long been recognized for their reliable and economical performance. Nordberg is proud of having supplied the engines and assisted the Compania Mexicana de Luz Y Fuerza, S. A. and the Comision Federal de Electricidad in the design of this mammoth public utility.

NORDBERG MFG. CO.
MILWAUKEE 7, WISCONSIN

NEW YORK • SAN FRANCISCO • WASHINGTON
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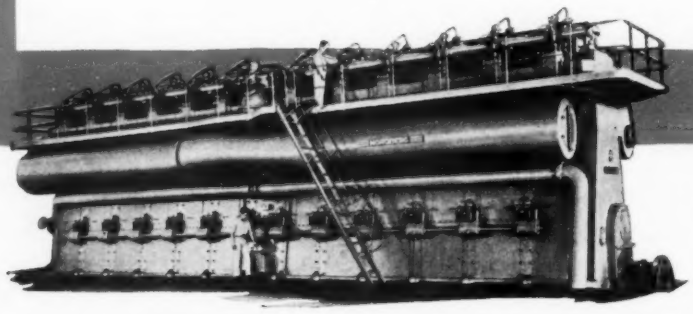


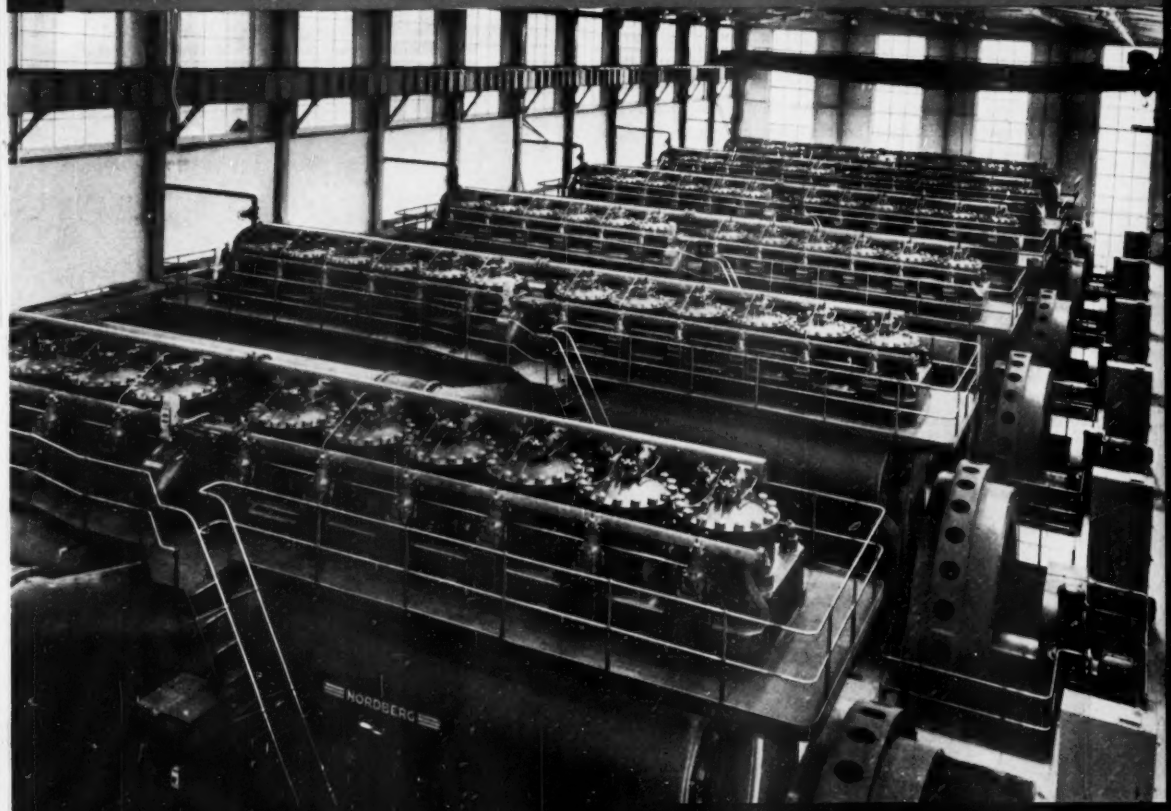
One of the six Nordberg Diesels installed at Tacubaya. In addition to these 8,650 H.P. units, Nordberg also builds an extensive line of Diesel and gas burning engines in two and four-cycle types for stationary and marine service from 10 H. P. up.

ELECTRIC PUBLIC UTILITY

powered with

SIX 8650 H. P. NORDBERG DIESELS

... On The Line 20 Months From Date Of Order



A DIVISION OF NORDBERG

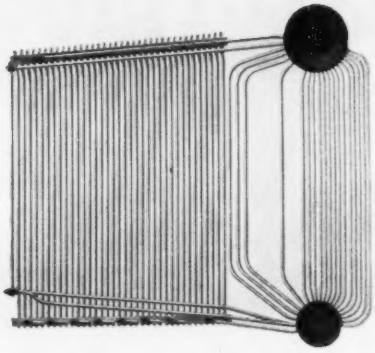
NORDBERG

DIESEL ENGINES

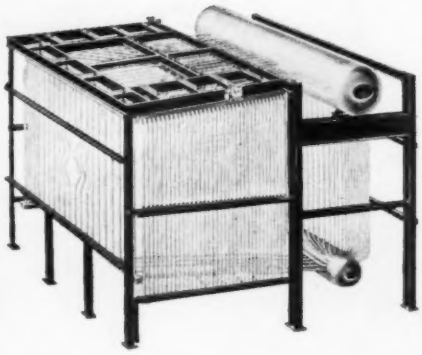
6 FEATURES of the VU Steam Generator that assure low-cost steam for medium and smaller plants

The structural features illustrated and described on these pages are to a large degree responsible for the efficient combustion, consistent production of dry steam at all ratings, high thermal efficiency, trouble-free operation and low steam costs which characterize the operation of the many hundreds of VU Steam Generators in service throughout the United States and in many foreign countries.

Designed to meet exacting, big-plant specifications, the VU Unit brings to medium-sized and smaller plants the advantages of Combustion's experience with high capacity, high pressure units, plus the obvious benefits of standardization. The VU Unit is virtually universal in application. It is available in capacities from 20,000 to 350,000 lb of steam per hr. It can be adapted to meet widely varying conditions of load, pressure and temperature. It can be fired with coal, oil, gas or any combination of these fuels. Compare its features item by item with those of any similar equipment on the market. They explain why the VU Steam Generator is so widely regarded as the finest equipment available for any steam requirements to which it is applicable. B-321



Symmetrical Design. Any section taken through the unit from the front to rear is similar to any other section so taken. Each elemental section includes the same amount of furnace volume, the same amount of boiler heating surface and the same amount of superheater surface as any other. The volume of gases, their velocity and temperature, at any point from front to rear, are practically constant across the width of the unit.



Overhead Suspension. Complete freedom of expansion in all directions is provided by suspension of all parts of the unit from the steel structure which provides the framework for the outer steel casing. This feature makes ample provision for the effects of temperature changes; it eliminates abnormal mechanical stresses on all pressure parts and explains to a large degree the freedom of the VU Unit from leaky joints.

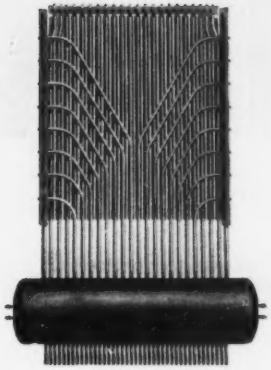
C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

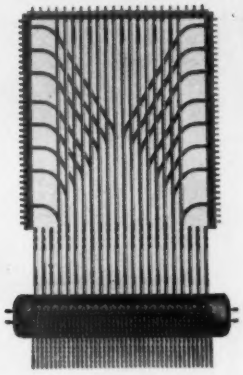
A Merger of Combustion Engineering Co., Inc. and The Superheater Co.

200 Madison Avenue • New York 16, N. Y.

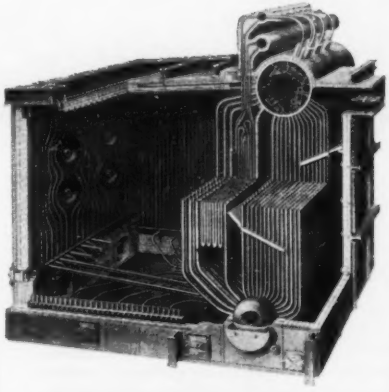
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



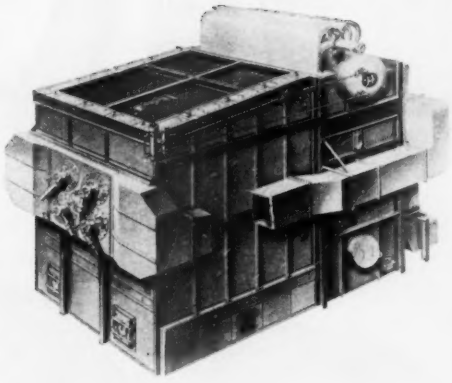
Quality Steam. All of the most active steam producing tubes enter a baffled area in the drum which discharges well above the normal water line and uniformly across the full length of the drum. This arrangement reduces turbulence to a minimum and permits effective utilization of the entire steam release space. Dry steam and a stabilized water level are thus assured even under adverse conditions.



Standardized Construction. Painstaking refinement of detail is incorporated in each unit at a small fraction of the original engineering cost. With standard parts and structural features the merits of which are confirmed by experience, manufacturing and erection costs are materially reduced. First cost reflects the economies of standardization and the buyer benefits even before the VU Unit is placed in operation.

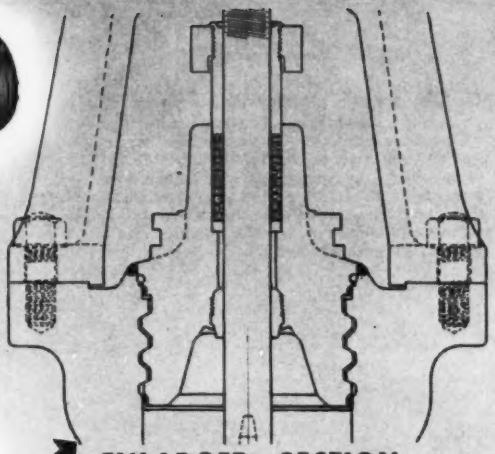


Adaptable In Application. The VU Unit can be adapted, without sacrifice of the benefits of standardization, to a great variety of conditions: where space limitations are imposed; to burn coal, oil, gas or any combination of these fuels; to meet widely varying requirements of load, pressure and temperature. Inclusion of inter-bank or inter-tube superheater or an air heater is easily accomplished as conditions require.



Steel Encased Setting. The unit setting of shaped tile, refractory and 100% insulation are attractively finished by a permanent outer steel casing. This design, evolved from careful study and experiment, reduces to a minimum heat losses caused by radiation and air infiltration. It tends to eliminate hot spots and helps maintain a uniformly low surface temperature throughout the steel casing. Maintenance is negligible.

Breech Lock



ENLARGED SECTION
BREECH LOCK JOINT

Breech Lock design also available in globe, angle, check and non-return valve patterns.

POSITIVE INSURANCE AGAINST BODY-BONNET JOINT LEAKAGE. NO MAINTENANCE REQUIRED.

Here's Why...

The Breech Lock design has no sealing surfaces to become damaged by corrosion, oxidation, or in disassembly, which might prevent reassembly of a tight body-bonnet joint.

Has no flanges, gasket, or bolting materials which demand periodic attention.

Joint tightness unaffected by sudden quenches, temperature variations, and creep.

Seal Weld leakproofs joint.

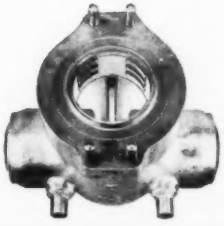
SEAL WELDED BONNET CAST STEEL VALVES . . .

Exclusively and Distinctively LUNKENHEIMER!

THE Breech Lock Valve is a patented design developed by Lunkenheimer to eliminate body-bonnet joint leakage on high pressure-high temperature service. In numerous installations in leading power plants the Breech Lock design has measured up to highest expectations, and definitely proved that it will not leak under the most severe operating conditions. Maintenance expense has been eliminated. A recent installation of these valves is in a central power station operating at pressures and temperatures up to 2100 psi at 1050° F.

The Breech Lock design is ideally suited for boiler feed and main steam line operation. All parts that tend to cause joint leakage because of their structural instability at high pressures and temperatures, have been eliminated.

If you are planning on expansion or the addition of new power plant units, we suggest consideration of the Breech Lock design. Lunkenheimer representatives and engineers will be glad to work with you.



Bonnet fits into body and lugs intermesh with a 45° turn to mechanically lock the two parts together. Heavily proportioned lugs provide necessary strength to carry full internal pressure load acting against bonnet. Precision machining of each lug assures even stress and perfect alignment of stem and other valve parts. Leakage past the joint is impossible as outer joint is covered by a seal weld.

Breech Lock circular No. 552, *yours for the asking.*

Write for Lunkenheimer Circular No. 552 which describes and illustrates Breech Lock Seal Welded Bonnet Cast Steel Valves. Also lists recommended body-bonnet casting materials for high pressure-high temperature services.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

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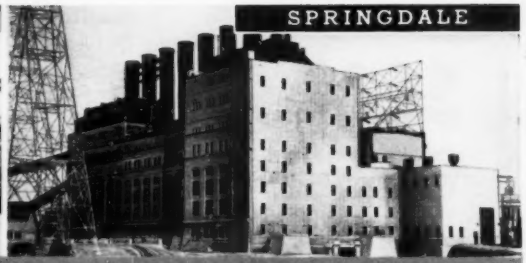
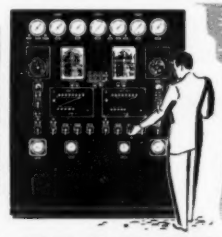


WEST PENN POWER CO. PITTSBURGH, PA.

A few
Outstanding

VULCAN

Automatic Sequential Soot Blower Installations in CENTRAL STATIONS

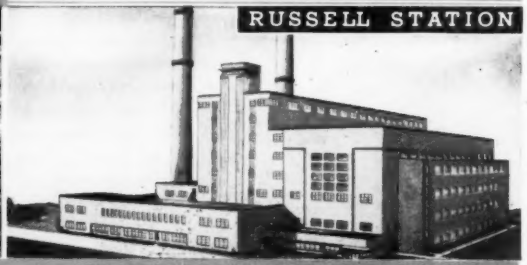


VULCAN SOOT BLOWER CORPORATION

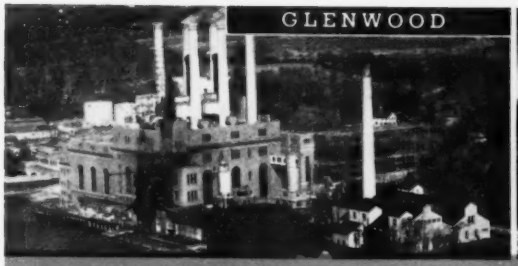
DUBOIS, PENNA.

DIVISION OF CONTINENTAL FOUNDRY & MACHINE CO.

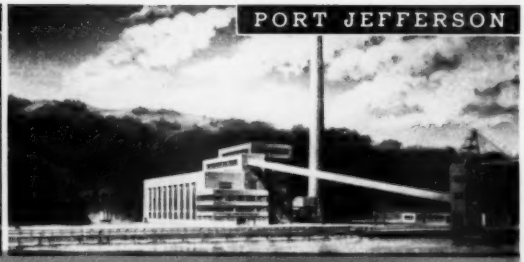
THE EMPIRE DISTRICT ELECTRIC CO.



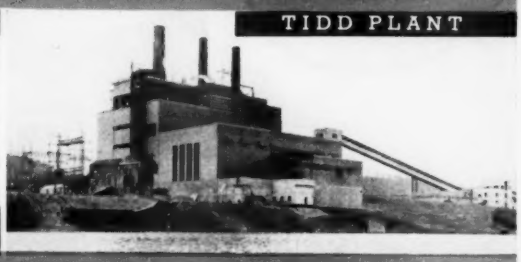
ROCHESTER GAS & ELECTRIC CORP.



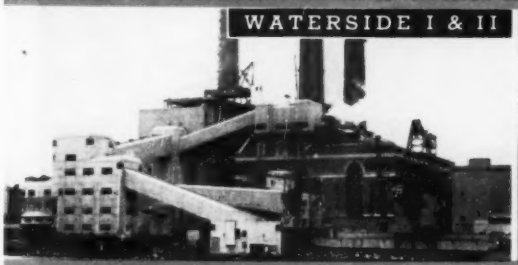
LONG ISLAND LIGHTING CO.



LONG ISLAND LIGHTING CO.



DESIGNED AND CONSTRUCTED UNDER SUPERVISION OF AMERICAN GAS & ELECTRIC SERVICE CORPORATION



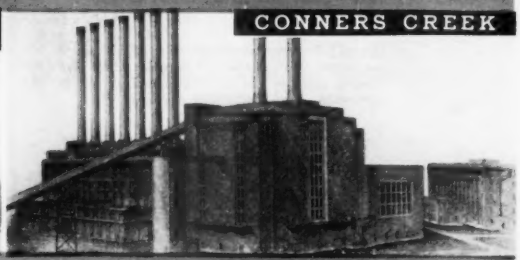
CONSOLIDATED EDISON CO. OF NEW YORK, INC.

THE CINCINNATI GAS & ELECTRIC CO.

PENNSYLVANIA POWER & LIGHT CO.

CONSOLIDATED EDISON CO. OF NEW YORK, INC.

PUBLIC SERVICE ELECTRIC & GAS CO.



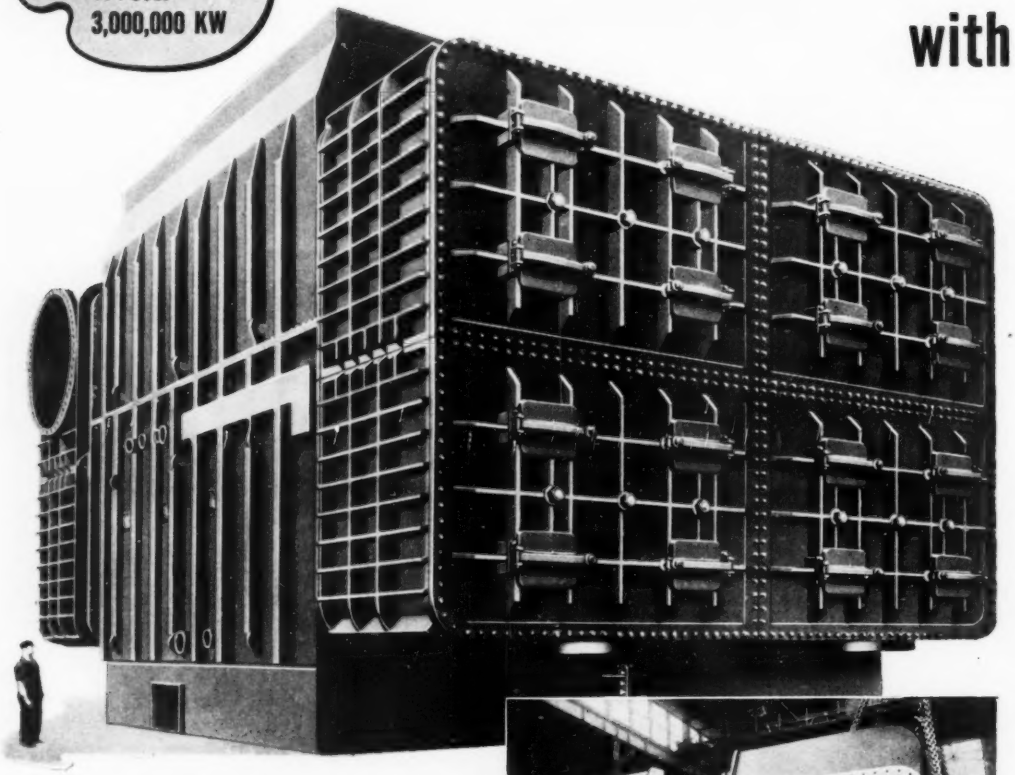
DETROIT EDISON COMPANY

Two Reasons Why

YOU SAVE SPACE

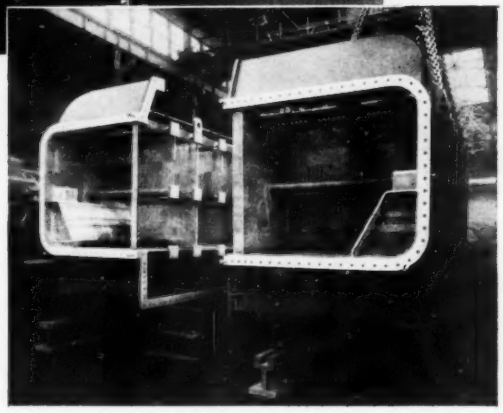
with

I-R Rectangular Design ... over 3,000,000 KW



(Above) This giant 90,000 sq ft condenser will serve a 150,000 kw turbo-generator. The compactness of the I-R design made it possible to fit the cube-shaped space available.

(Right) Factory assembly of a 32,500 sq ft condenser. Notice the full flanged joints and bolting pads of the internal bracing, which eliminate field-fitting and welding.



COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

and ERECTION COSTS

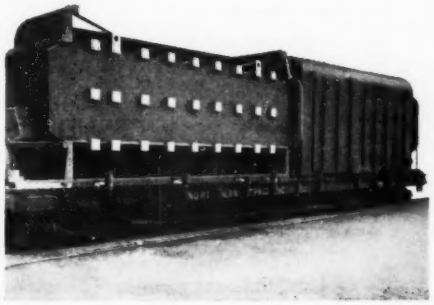
I-R Rectangular Condensers

1 RECTANGULAR DESIGN to fit a rectangular space

BACKED BY OVER 3,000,000 KW. Post-war installations and orders for Ingersoll-Rand condensers of *rectangular design* to serve over 3,000,000 kw of turbo-generators prove that utilities are taking advantage of the savings in this compact, high efficiency condenser. I-R Rectangular Condensers, built with liberal design proportions, make the most efficient use of the rectangular space available under the turbine foundations.

Twenty-seven years ago Ingersoll-Rand broke with tradition in setting a new standard in heat-transfer efficiency which greatly reduced the amount of surface and physical size of a condenser required for a given capacity. This I-R pioneered design provided positive control of the steam flow through a low-friction-loss tube nest, thereby eliminating "drone" surface and causing all the tubes to work at a maximum condensing rate.

For years these features were built in the famous "Heart Shape" shell. Today to meet the even more stringent space requirements *Ingersoll-Rand has again led the field* by successfully incorporating these time-proven features in a still more compact rectangular shell.



A condenser, now in sections, on its way to the customer's plant. When erected all parts lined-up perfectly and there was a minimum of field welding. No field welding is necessary on I-R condensers being built today.

2 Complete FACTORY ASSEMBLY and FLANGED CONSTRUCTION to eliminate field-fitting and welding

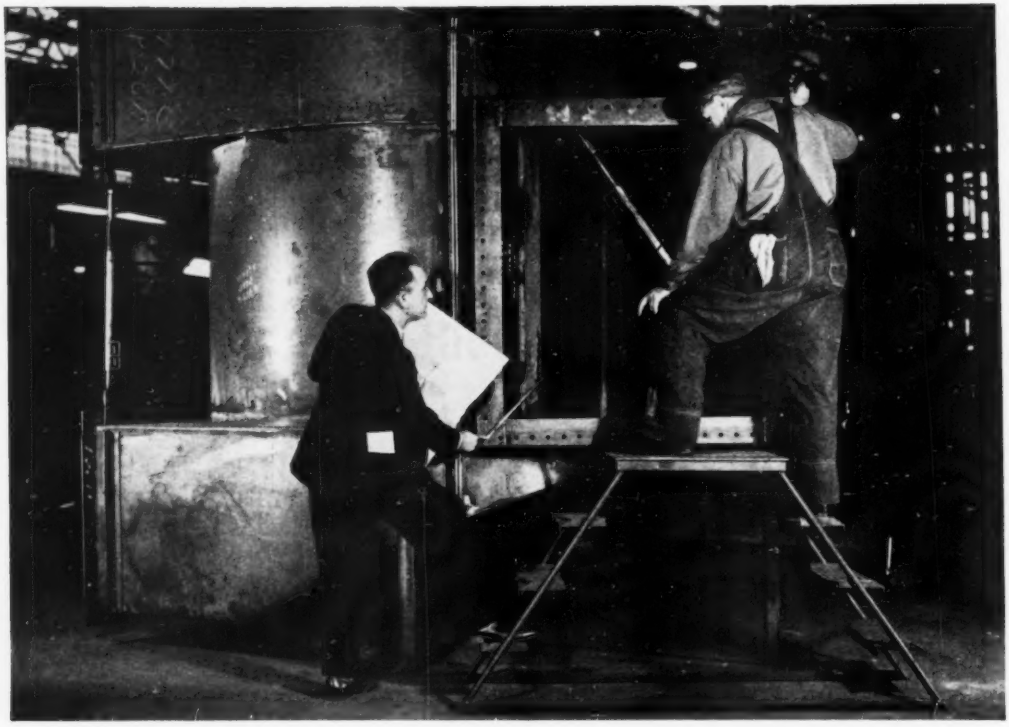
Every I-R condenser is completely assembled and hydrostatically tested in the factory. On units that are too large to ship in one piece, all mating surfaces of each section are machine-flanged, aligned, and dowelled. All internal bracing which must be split for shipment is also machine-flanged.

Thus when these sections arrive at the customer's plant they are easily bolted together with no field-fitting necessary. No erection welding is required in the field. "Flanged Construction" is an I-R tradition . . . in use since 1922.

These and other exclusive features of Ingersoll-Rand Surface Condensers combine to save you money.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 435-4



Experience is a great teacher!

Here, Jim Cordell and Bob Austin, veterans of more than 20 years with American Blower, check a new Mechanical Draft Fan against blueprints for the Madison Gas and Electric Company, Madison, Wisconsin.

Bob Austin recalls a similar job he worked on for this same utility in 1937. It is still giving dependable service. Naturally, Bob has an added incentive to live up to his reputation on this job.

We believe, and we're sure you'll agree, that personal attention like this makes for better jobs and better over-all performance of equipment on the job.

When you buy American Blower Mechanical Draft Fans, Fly Ash Precipitators, or Gýrol Fluid Drives for boiler feed pumps and fan control equipment, you buy this experience. We believe that your careful consideration of the facts will prove that it costs you less in the long run to utilize this experience.

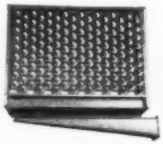
Phone your nearest American Blower Branch Office for full data! There is no obligation.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.

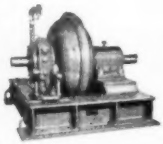
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

HS and Sirocco Fans for forced or induced draft in all types of power plants.



ST Fly Ash Precipitators—especially for power plants burning pulverized fuel.



Type VS Gýrol Fluid Drive—for adjustable speed control of mechanical draft fans.

AMERICAN BLOWER

Serving home and industry

AMERICAN STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILER • ROSS HEATER • TONAWANDA IRON

accuracy

ROCKING CONTACT

with Allis-Chalmers ROCKING CONTACT Generator Voltage Regulator

THEY'RE precision-built like fine watches. Contact sectors are supported in jeweled bearings . . . rock on carefully machined commutator segments heavily plated with silver for reliable, long-life accuracy.

And the Rocking Contact principle offers you instant response . . . low maintenance, too. The regulator operates directly in the exciter shunt field circuit . . . without time-wasting relays. Complex adjustments, vibrating contacts, gliding friction have all been eliminated to help reduce your maintenance problems.

Rocking Contact Regulators are available for both a-c and d-c generators of any size and speed, for either parallel operation or unit control. Call our representative in your nearby A-C office or write direct. A 2584

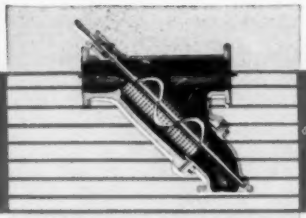
ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Type 366 Rocking Contact Regulator. Hinged glass front door allows easy inspection of moving parts.

ALLIS-CHALMERS

Pioneers in Power and Electrical Equipment From Generation Through Utilization

CLEAN



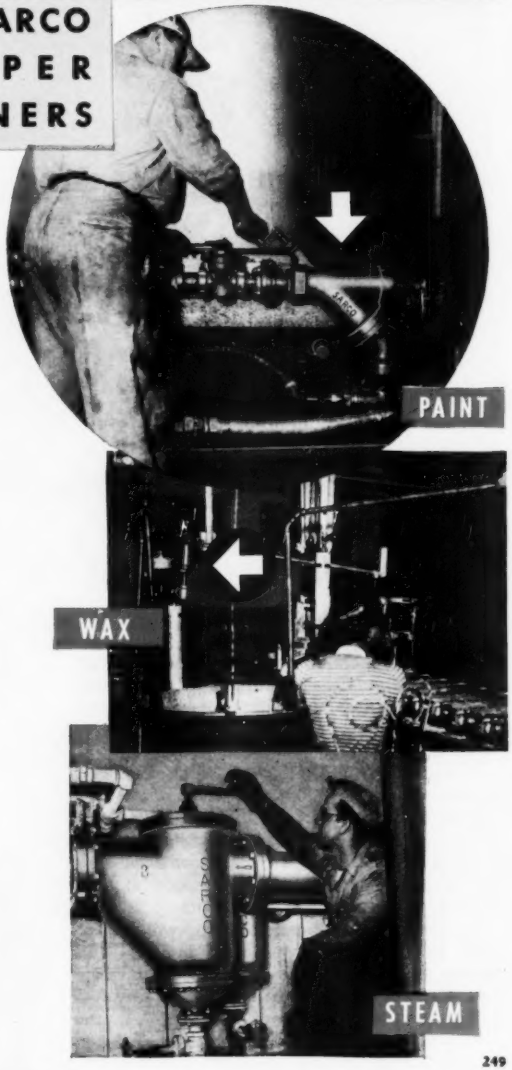
PAINT, WAX
STEAM . . .
OR ANY LIQUID

WITH SARCO
SCRAPER
STRAINERS

Any liquid that can flow through a pipe can be free from impurities down to any size screen you select, with the Sarco Scraper Strainer. It's the last step and a final insurance of the product just before packaging. In the paint plant illustrated, a Sarco is on each of the three tanks in front of the automatic canning machine. The strainer screens are cleaned every few hours by a turn of the handle.

In a large metal plant, exhaust steam from hammers, formerly unusable because of the lint and dirt, is now used for heating. Food syrups, river water and hot wax are other applications.

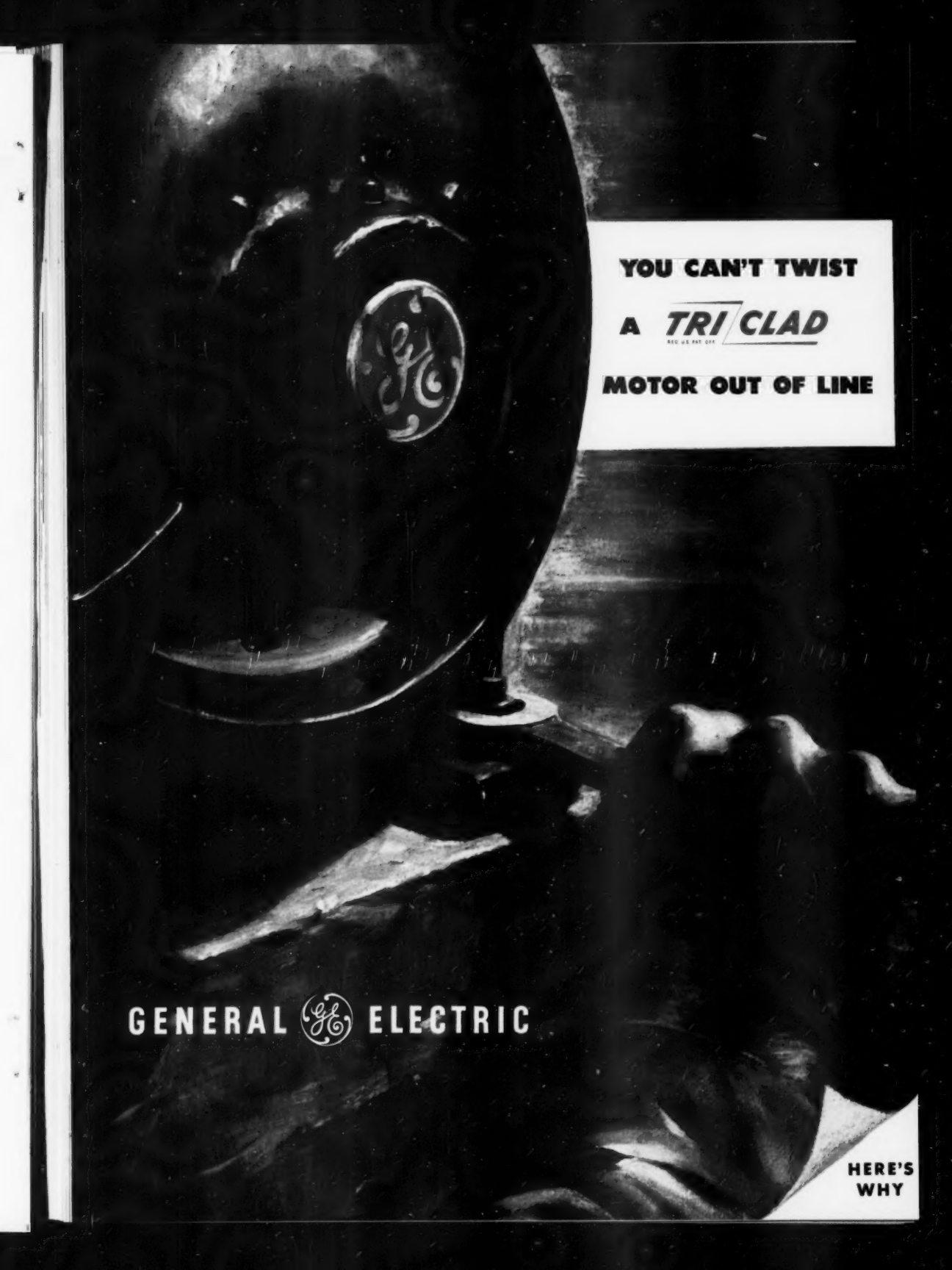
Standard Sarco Strainers are made in four types, ¼" to 8" for pressures up to 900 pounds. Scraper strainers ¾" to 8" and 200 pounds, hand or motor operated. Ask for Catalog Nos. 1200 and 1225.

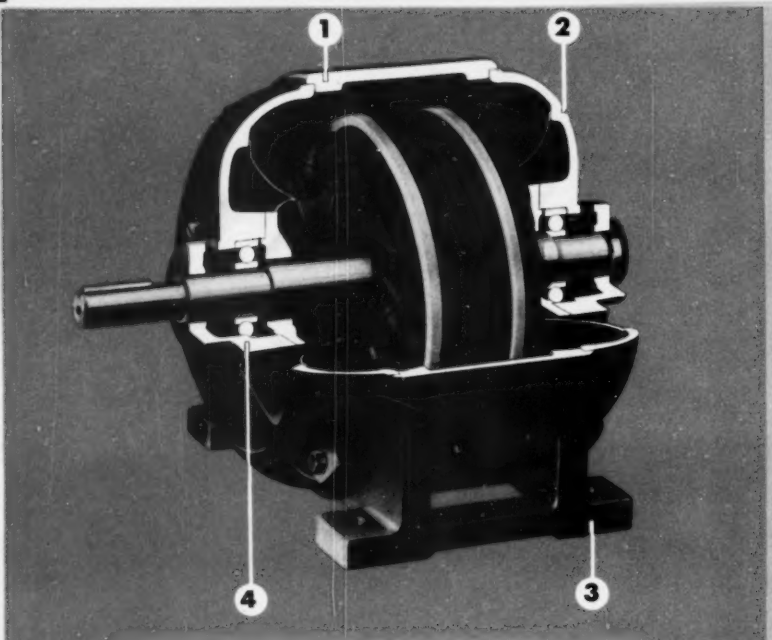


249

SARCO
SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO


YOU CAN'T TWIST
A TRI CLAD
REG. U.S. PAT. OFF.
MOTOR OUT OF LINE
GENERAL ELECTRIC
HERE'S
WHY



Look at the solidity of a Tri-Clad's thick-section cast-iron frame (1) and heavily reinforced end shields (2) . . . its heavy integrally cast feet (3). Do you wonder we say "Tri-Clad gives you structural strength and rigidity no other general purpose motor can match"? Notice, too, the *completely* enclosed bearings (4). A Tri-Clad motor will run safely without relubrication for years — as long as any general-purpose motor you can buy. Yet it's grease-gun easy to lubricate if you ever need to.

You can't twist a TRI CLAD motor out of line

Try as a heavy-muscled mechanic may, he can't twist a Tri-Clad motor frame when bolting it to an uneven surface. The bolt will snap before he can pull that rigid cast-iron structure out of line.

Important? It's one of the basic reasons General Electric believes cast iron to be the ideal structure for general-purpose industrial motors. Other reasons? Cast iron has unusually high resistance to rust and corrosion. It has an inherent damping action that minimizes resonance. And . . . it won't take on an injurious permanent "set" as a result of accidental blows or mechanical abuse.

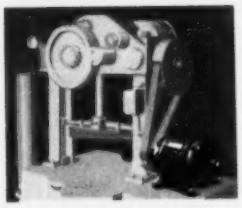
Want a motor that's been **SERVICE-PROVED** in 5 billion hours of rugged industrial use? Nearly all types and ratings are **AVAILABLE FROM STOCK.**

Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

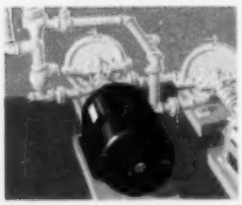
GENERAL ELECTRIC

740-10

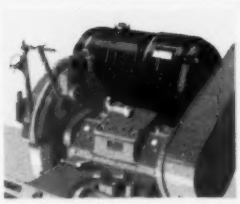
YOU CAN'T BEAT TRI CLAD EXTRA PROTECTION



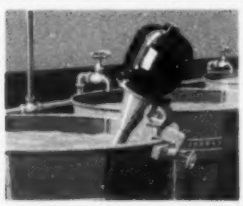
G-E open (drippproof) induction motors for constant-load, constant-speed applications. From 1 to 2000 hp.



G-E totally enclosed motors for outdoor operation, in abrasive dusts, or corrosive fumes. From 1 to 1000 hp.



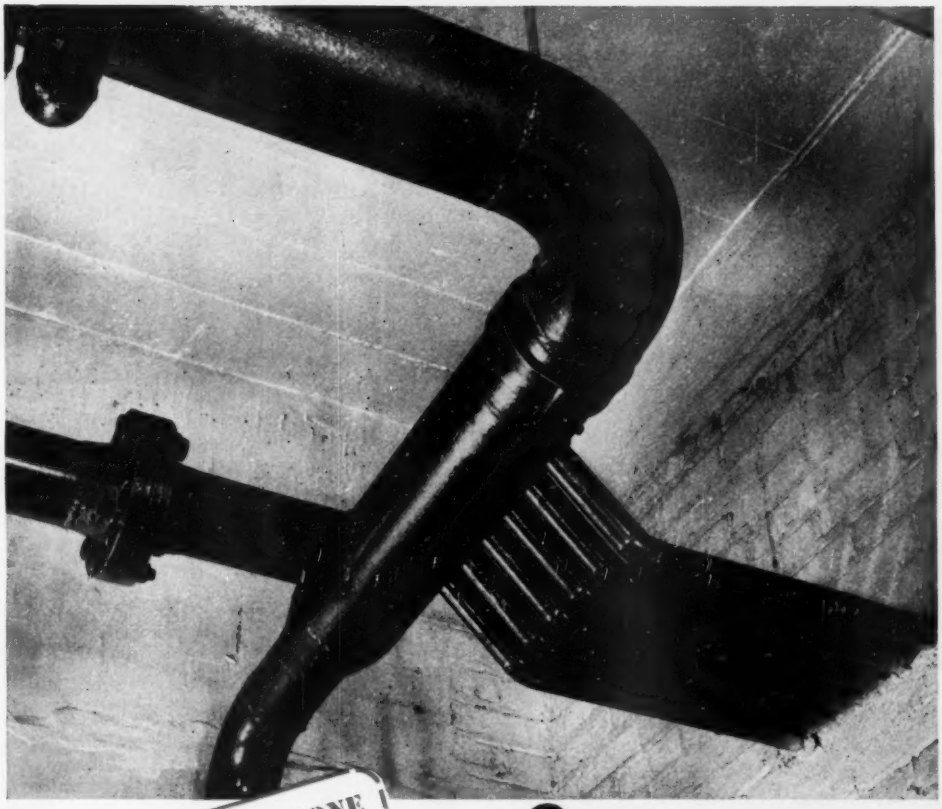
G-E Type ACA induction motors for adjustable speeds — provide 3 to 1 speed range. From 3 to 75 hp.



G-E flange and face-type motors for use where the machine supports the motor, or vice versa. From 1/20 to 60 hp.

Look for this **EXTRA** on the motor you buy!

How to Tame a Tough Joint



ANOTHER JOB DONE BETTER WITH GLOBE WELDING FITTINGS

KEEP an eye on the future when you install piping — even the most innocent looking connection can become a "tough joint" through leakage — pressure-loss — the focal point for erosion and corrosion — constant maintenance time and cost.

You can tame probable "tough joints" in piping by making connections with permanently tight, leakproof Globe Welding Fittings. Strength is forged in the fittings — flow friction and pressure-loss minimized by precision formed true angles, radii, circularity — weight and space requirements reduced — exact dimensional accuracy that saves time, speeds piping assembly. To do any piping job better — use Globe Welding Fittings produced from Globe seamless steel tubes by the Globe Precision Process.

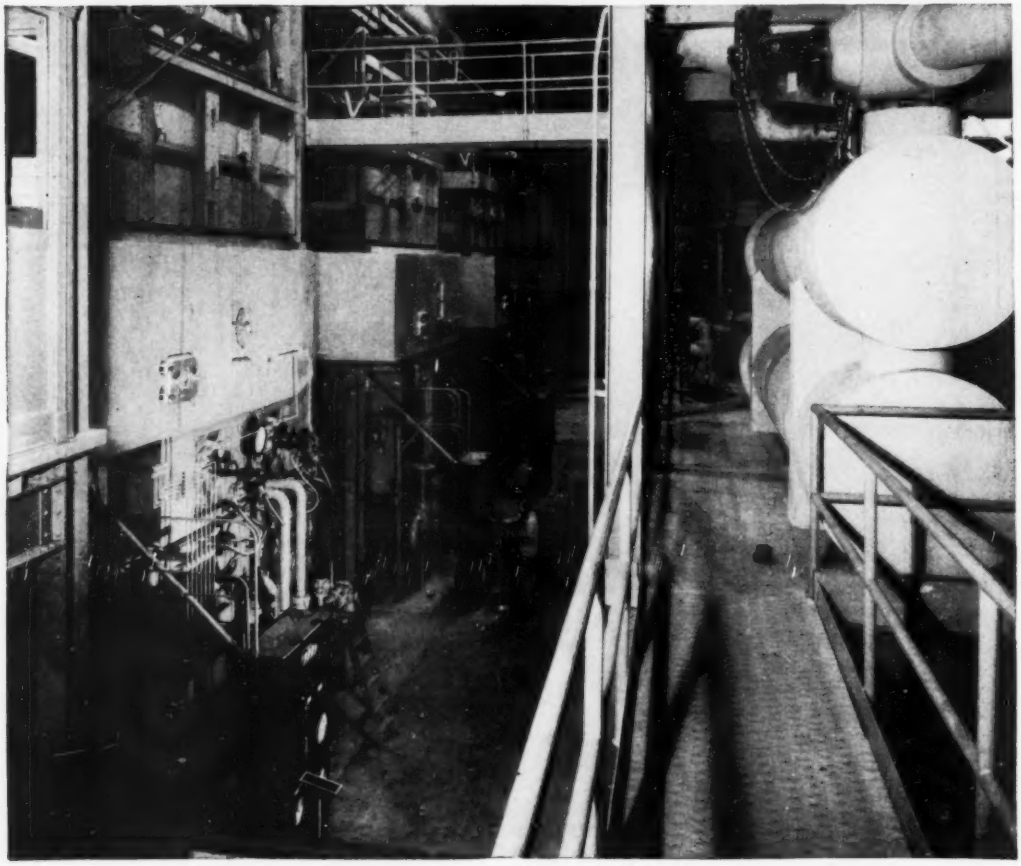
GLOBE STEEL TUBES CO., Milwaukee 4, Wis.

Producers of Globe seamless stainless steel tubes — Gloweld Welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

For complete information on sizes and types send for Globe Welding Fittings Catalog.

GLOBE PRECISION PROCESS WELDING FITTINGS

Today—More Republic



Interior view of a 400,000 lb. steam generating plant in a modern industrial plant. Steam is generated in these gas fired boilers which are operated by a Republic automatic combustion control system.

The installation of Republic automatic controls on your boiler (or boilers) will enable you to:—

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hours a day, 7 days a week.

CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently develops as a result of incorrect boiler operation.

REPUBLIC
INSTRUMENTS
AND CONTROLS

Combustion Control Systems

ARE BEING SPECIFIED THAN EVER BEFORE

because...

Built into the Republic combustion control systems are the many important features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of everyday operation.

Check the following features against your list of "musts" when specifying a perfect combustion control system.

CENTRALIZED CONTROL:
The operation and control of the boiler or boilers is centralized at the master controller.

FUEL-AIR RATIO INDICATOR:
The master controller is provided with mercury manometers or gages which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

FUEL-AIR RATIO ADJUSTMENT:
A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

FUEL VARIATIONS:
Automatically compensates for variations in fuel to maintain combustion conditions constant.

ALL BOILER RATINGS:
Maintains proper fuel-air ratio over the entire range of boiler ratings.

CONSTANT STEAM PRESSURE:
Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

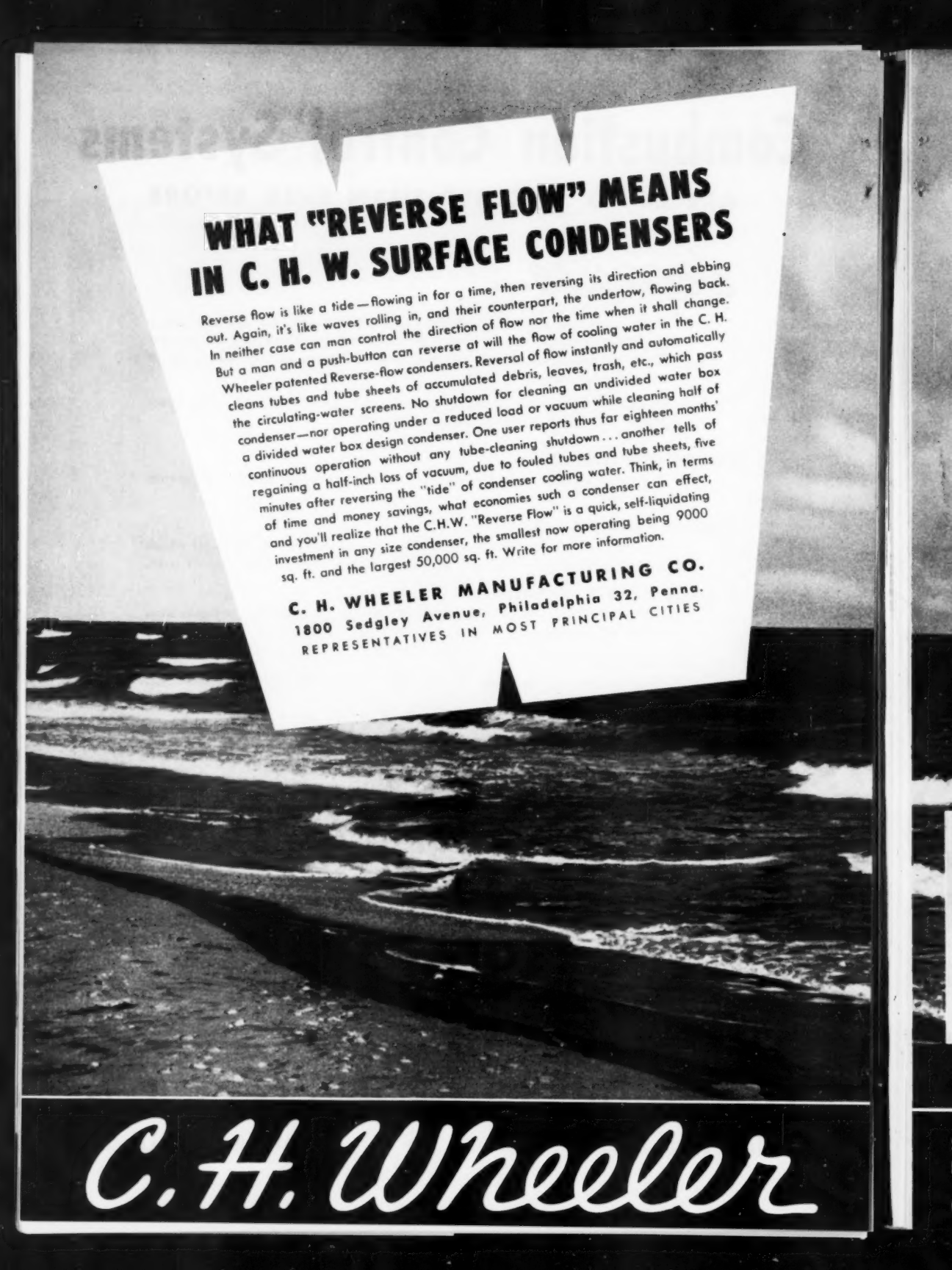
LOAD DISTRIBUTION:
Provides a means of distributing the load among the boilers as desired.

MANUAL CONTROL:
Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

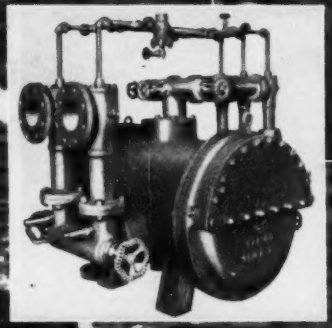
Find out about Republic control systems. One of our engineers will be glad to consult with you at any time without obligation on your part. Write us today.

Republic Flow Meters Co.

2240 Diversey Parkway • Chicago 47, Illinois


WHAT "REVERSE FLOW" MEANS IN C. H. W. SURFACE CONDENSERS
Reverse flow is like a tide—flowing in for a time, then reversing its direction and ebbing out. Again, it's like waves rolling in, and their counterpart, the undertow, flowing back. In neither case can man control the direction of flow nor the time when it shall change. But a man and a push-button can reverse at will the flow of cooling water in the C. H. Wheeler patented Reverse-flow condensers. Reversal of flow instantly and automatically cleans tubes and tube sheets of accumulated debris, leaves, trash, etc., which pass the circulating-water screens. No shutdown for cleaning an undivided water box condenser—nor operating under a reduced load or vacuum while cleaning half of a divided water box design condenser. One user reports thus far eighteen months' continuous operation without any tube-cleaning shutdown . . . another tells of regaining a half-inch loss of vacuum, due to fouled tubes and tube sheets, five minutes after reversing the "tide" of condenser cooling water. Think, in terms of time and money savings, what economies such a condenser can effect, and you'll realize that the C.H.W. "Reverse Flow" is a quick, self-liquidating investment in any size condenser, the smallest now operating being 9000 sq. ft. and the largest 50,000 sq. ft. Write for more information.
C. H. WHEELER MANUFACTURING CO.
1800 Sedgley Avenue, Philadelphia 32, Penna.
REPRESENTATIVES IN MOST PRINCIPAL CITIES
C. H. Wheeler

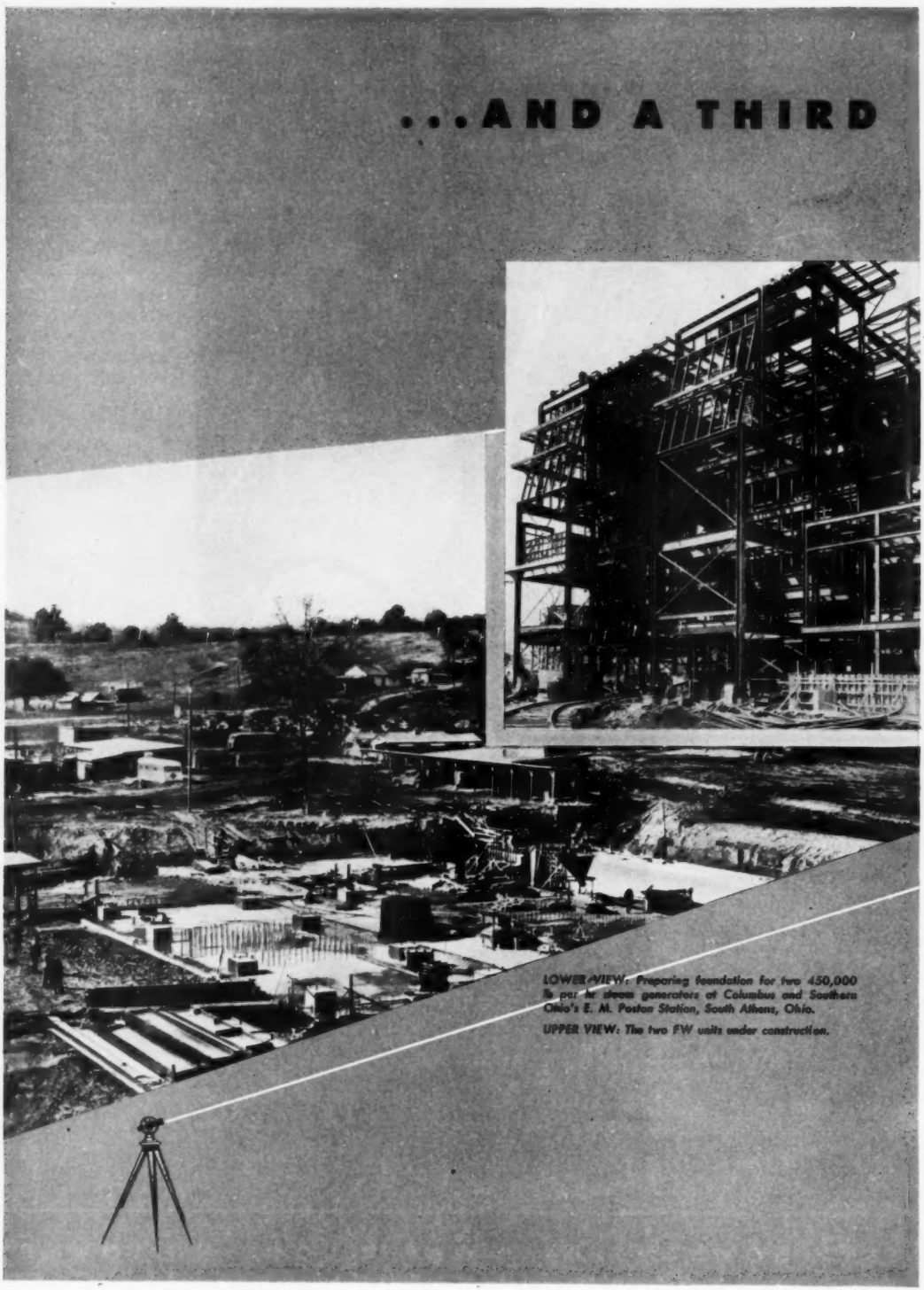
WATER COOLING TOWERS
. . . for power and process applications and for use with air conditioning systems.



STEAM JET EJECTORS
for power plants; also single and multi-stage ejectors with barometric or surface condensers for process applications.

STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION

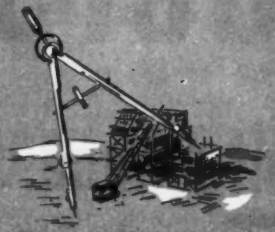
OF PHILADELPHIA

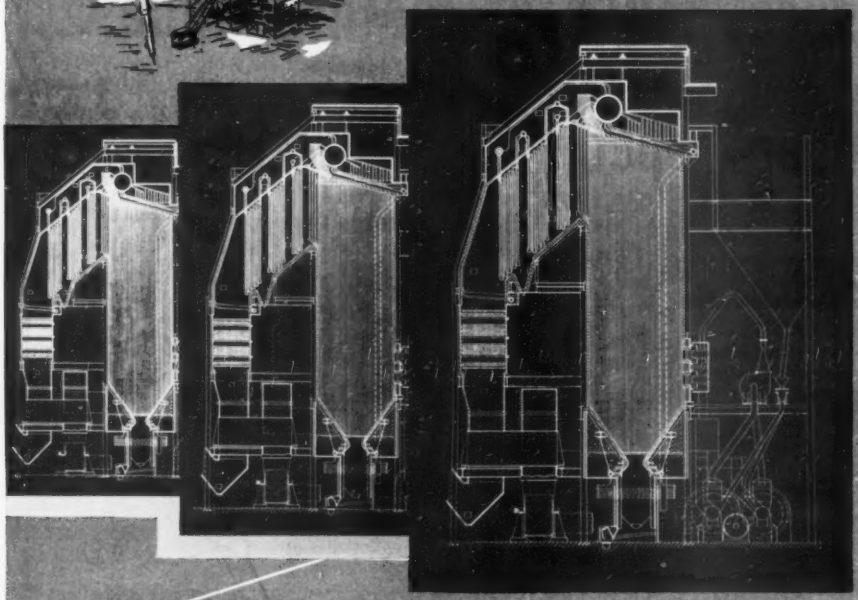


LOWER VIEW: *Preparing foundation for two 450,000 lb per hr steam generators at Columbus and Southern Ohio's E. M. Poston Station, South Athens, Ohio.*

UPPER VIEW: *The two FW units under construction.*

UNIT ON THE WAY





A DESIGN WHICH PROMISES FIRST COST SAVINGS AND LONG RANGE ECONOMY

Two Foster Wheeler steam generators with a combined steam capacity of 900,000 lb per hr are now being erected at Columbus and Southern Ohio's E. M. Poston Station, located at South Athens, Ohio.

A third and larger unit of the same design, recently ordered, will have a capacity of 625,000 lb of steam per hr.

These units are typical of the single-pass design which Foster Wheeler is using as the basis for "Preferred Standard" steam generators. This standardized steam generator pattern with fixed individual equipment details may be readily applied to a series of single or twin furnace units, varying in capacity from 300,000 lb of steam per hr to over 1,000,000 lb per hr. The design also embodies Foster Wheeler features of slag-free furnace arrangement, Foster Wheeler condenser-type steam temperature control, low draft loss, and efficient heat recovery equipment.

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

Third Foster Wheeler Unit for
E. M. Poston Station
of
Columbus and Southern Ohio Electric Company

Capacity	625,000 lb per hr
Superheat control range	450,000 to 625,000 lb per hr
Pressure superheater outlet	1350 psi
Final steam temperature	955 F
Bituminous coal pulverized in FW ball mills	

FOSTER WHEELER

Repeat Orders

Tight closure, low-cost maintenance,...

leading users *always* specify *Edward*

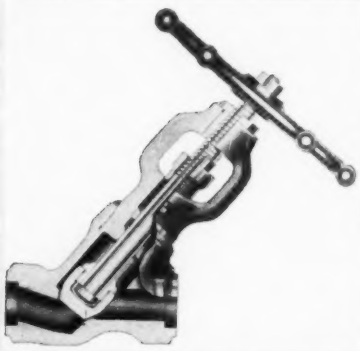
TYPICAL CASES

1. 40 Years Ago, these Edward blow-off valves were installed in a prominent industrial plant. After 40 years of continuous

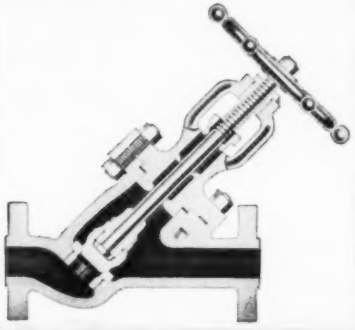
service, thousands of operations, and only minor repairs, they're still in satisfactory service.

2. This installation is in a famous mid-western power station. Edward blow-off valves were selected because of their trouble-

free performance, going back many years, in three of the company's earlier stations.



HIGHER PRESSURES
— Integral bonnet, integral seat, hard-faced disk for pressures up to 2500 lb.

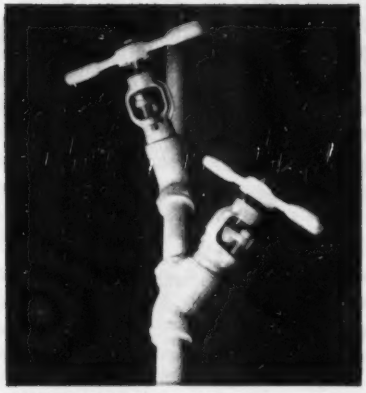


LOWER PRESSURES
— 300 lb straightway design, typical of Edward simplicity, few working parts.

Prove Satisfaction

easy operation explain why hundreds of

BLOW-OFF VALVES



NEW! **Now you can have the famous Edward Impactor operating mechanism in "T" handle design for small valves. Simplifies valve operation, gives extra tightness with no cinching or "cheaters." Especially adapted to blow-off valve service, and exclusive with Edward.**

80% REPEATERS

Of all Edward boiler blow-off valves installed during the past year, over 80 per cent went to repeaters—to utilities, municipals and industrials who know what they're buying because they've had Edward blow-off valves in successful operation on other units for years.

Edward builds blow-off valves for every service where steel valves are used—for pressures from 150 to 2500 lb, in bolted or integral bonnets, in flanged or welded ends. Because they're so basically simple, maintenance is never much of a problem. With no unequal metal sections to distort in heating and cooling, the Edward valves close tight and stay tight.

Look at the record—send the coupon for your copy of "Who's Who Among Edward Blow-off Valve Users," and Catalog 12-D.

Another Product

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

EDWARD VALVES, Inc.
1220 West 144th Street, East Chicago, Ind.
Please send me Catalog 12-D and typical Installation List.

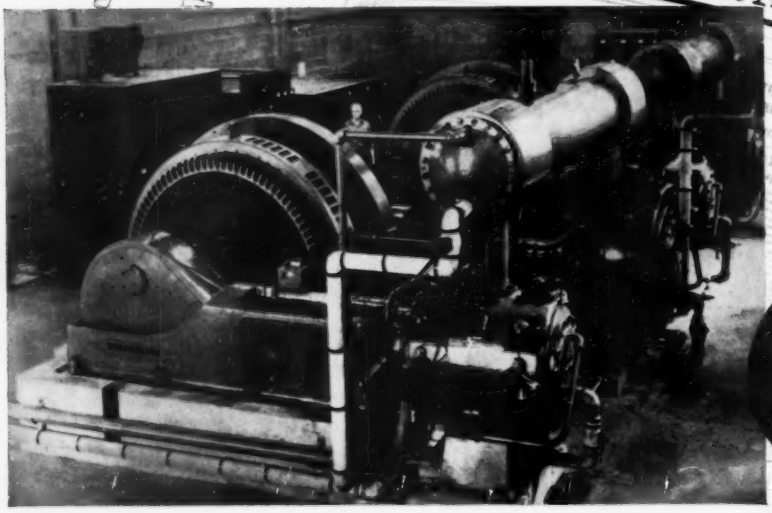
Name_____

Company_____

Street_____

City_____ Zone_____ State_____

LONG-RANGE FORECAST: "Considerably Cooler with Lower-Cost Air"



Worthington Horizontal Duplex Compressors, Type DC-2
A plant installation of two 600 hp units

You can depend on this prediction of Worthington compressor-performance to be 100% accurate — every time! In DC-2's, for example, cooler operation is assured by such exclusive Worthington features as:

- **Advanced Variable Capacity Control** — Most modern, simple and flexible ever devised. Accurate, automatic regulation that cuts down operating heat with better lubrication and reduced carbon deposits.
- **Improved Intercooling** — High-efficiency design that provides maximum cooling with minimum water, for lower power requirements and lower operating temperatures.
- **Feather*Valves**—Lightest, tightest, most efficient ever made — a famous Worthington contribution to compressor-development.

These and many other DC-2 advantages mean not only more air for less money, but longer compressor life and constant savings in power and maintenance costs. Bulletin L-675-B1A has the complete story that proves *there's more worth in Worthington*. Write for your copy to *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.* *REG. U. S. PAT. OFF.

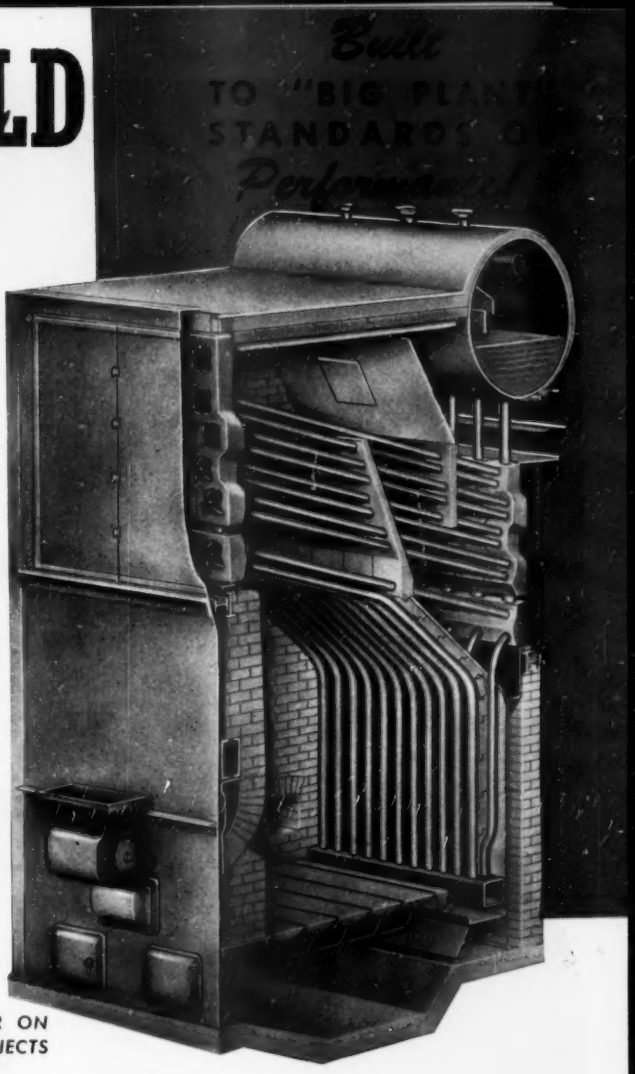
WORTHINGTON

K9-8

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

SPRINGFIELD *Standardized*

TYPE MC COAL FIRED BOILERS



Choice of Sizes —Here is Springfield's new *Standardized* Type MC boiler. Available in a wide choice of sizes to help you meet small to medium size steam plant needs with minimum delay and less capital investment.

Standardized Construction — Boilers are assembled from same component parts. Height and depth are standardized. Width varies according to number of sections used.

Coal, Oil or Gas Firing — Designed for coal firing with standard stokers. Equally adaptable to high efficiency firing with standard oil or gas burners.

Quicker Delivery — Stocks of parts are maintained for prompt assembly and shipping of units. For information on delivery, see your local Springfield representative, or write.

CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS

SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.

STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.

STANDARDIZED TYPE M BOILERS—Standardized for quicker delivery and lower cost. Sizes 7,500 to 17,000 lbs. per hour.

WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.

SUPERHEATERS — AIR HEATERS — ECONOMIZERS—Individually designed to meet requirements.

BOILER No.	510	610	710	810	712	812	912	1012
Steam Capacity, Lbs. per Hr., continuous	7,500	9,000	10,500	12,000	12,500	14,300	16,000	17,800
Heating Surface, Sq. Ft.	895	1,077	1,256	1,430	1,490	1,703	1,918	2,128
Furnace Volume, Cu. Ft. Oil or Gas	305	360	415	475	550	625	700	775
Stoker	270	320	370	424	485	555	620	690
Furnace Width	4'7½"	5'6"	6'4½"	7'3"	6'4½"	7'3"	8'1½"	9'0"
Overall Width	8'2½"	9'1"	9'11½"	10'10"	9'11½"	10'10"	11'8½"	12'7"
Overall Length	11'11¼"	11'11¼"	11'11¼"	11'11¼"	13'10¼"	13'10¼"	13'10¼"	13'10¼"
Overall Height	19'4"	19'4"	19'4"	19'4"	19'4"	19'4"	19'4"	19'4"
Furnace Depth	7'10"	7'10"	7'10"	7'10"	9'7"	9'7"	9'7"	9'7"
Steam Outlet Size	4"	6"	6"	6"	6"	6"	6"	6"
Feed Inlet Size	1½"	1½"	2"	2"	2"	2"	2"	2"
Blow Off Size	2"	2"	2"	2"	2"	2"	2"	2"

SPRINGFIELD BOILER CO.

1953 E. Capitol Avenue — Springfield, Illinois

Worldwide Sales and Service

NEW YORK • PHILADELPHIA • WASHINGTON, D. C. • DETROIT • NATICK, MASS. • HOUSTON
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Export: READING, PA.

See our catalog in SWEET'S

When the Oklahoma Territory was opened at 12 noon on April 22, 1889, more than 20,000 people were lined up on the border. At a signal by U.S. Cavalry, a remarkable race for homesteads ensued.

Fig. 150—150-pound Bronze Globe Valve with screwed ends, union bonnet and renewable composition disc.

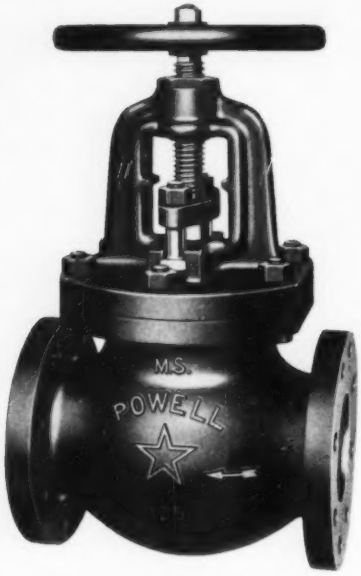


Fig. 241—Large 125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", inclusive. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.

Fig. 11331 W. E.—Class 1500-pound small size Cast Steel Pressure Seal Bonnet Globe Valve with welding ends. This design permits practically unobstructed flow through the valve body, thus reducing pressure drop and turbulence to the minimum.

POWELL

ALWAYS NEW FRONTIERS *for* POWELL

The amazing development of the United States has been a result of continually opening new frontiers—not only geographical, but scientific and industrial as well. In the latter sphere The Wm. Powell Company has a long and proud record of settling the flow control requirements of each new industrial frontier as it has appeared—including such achievements as inventing the first regrinding globe valve, pioneering in the field of corrosion resistance, meeting the need for specially designed valves for special services, and many others.

As a result of this continual pioneering, *only* Powell makes such a complete line* that no matter what your flow control requirements may be, Powell has *all* the valves needed to meet them. Moreover, Powell Engineers are always ready to help you solve any problems that might arise.

Fig. 500—125-pound Bronze Gate Valve with screwed ends, screwed-in bonnet, inside screw rising stem and tapered solid wedge in sizes ¼" to ¾", inclusive; double wedge in sizes 1" to 3", inclusive.

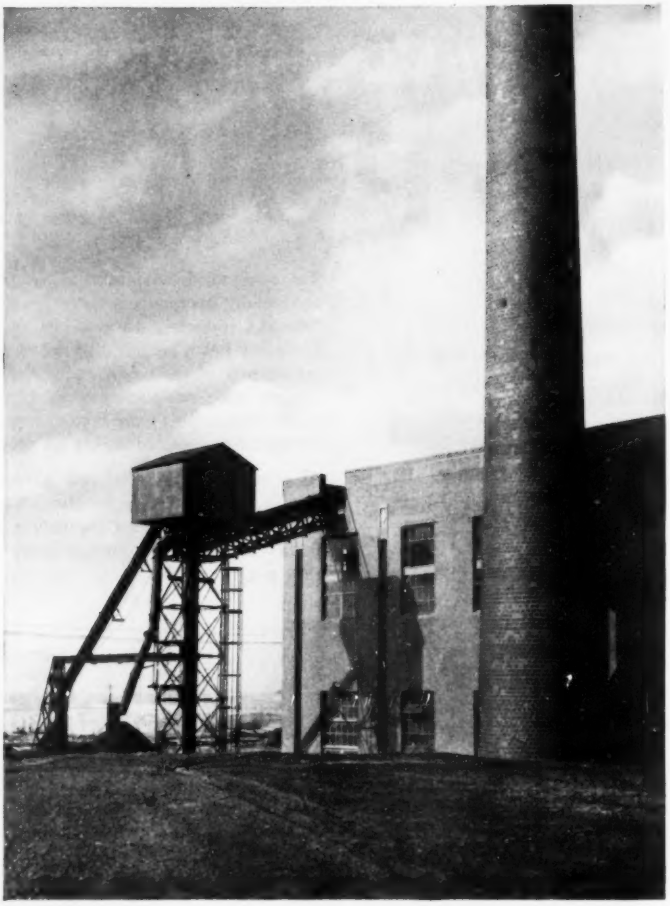
Fig. 11365 W.E.—Class 1500-pound Cast Steel Horizontal Lift Check Valve with welding ends, Pressure Seal Cap, and piston-guided disc. Streamline design permits maximum flow through the valve with minimum pressure drop.

* Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES



Eight Hungry Mouths To Feed–

At Everyday Low Cost...

Day-after-day low cost feeding of eight hungry mouths of boiler house bunkers . . . direct from track hopper or from outdoor storage . . . is the economical job an S-A Conveyor System does at this power plant.

The long experience of S-A engineers in solving bulk materials handling problems enables them to provide installations that meet the most specialized needs. Design and engineering of conveying systems that handle large volume at lowest cost per ton is the job they have been doing successfully for years.

Before you buy a new unit or plan a new conveyor system, take advantage of the years of experience of S-A engineers. They will submit their recommendations to you with no obligation on your part. Write today.

OTTAWA SILICA COMPANY
OTTAWA, ILLINOIS

Coal is picked up from track hopper without need for feeder and moved by Redler closed-circuit conveyor-elevator either to outdoor storage or up inclined belt conveyor to horizontal Redler conveyor on roof. Maximum coal storage in boiler house bunkers is obtained by placing Redler conveyor on roof where it piles coal up snug to roof through any one of eight openings. Coal is reclaimed from outdoor storage by means of Redler elevator and a power drag-scraper system.

STEPHEN S-A DAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

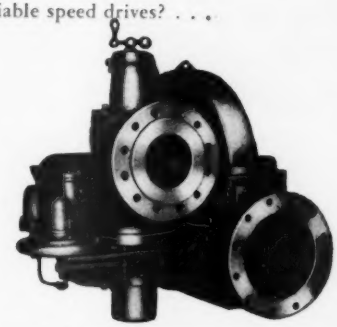
DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

TURBINE TIPS no. 1

question: Are turbines a good choice for variable speed drives? . . .

answer:

Yes. For instance, in cases where automatic speed control is desired, many pump, fan and compressor drives are equipped with either an air motor regulator (as shown) or a remote governing valve. With such an arrangement speed may be automatically controlled in terms of such variables as pump discharge pressure, differential pressure, temperature, etc.

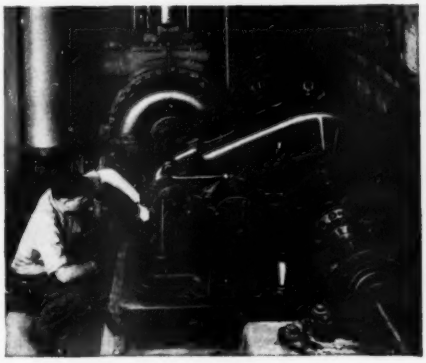


STANDARD TYPE DP TURBINE WITH REGULATOR

question: What kind of turbine should be selected for hand control of variable speed drives? . . .

answer:

Several designs of General Electric governors are available, making it possible to obtain any desired speed range by either hand adjustment or push-button adjustment in case remote operation is desired. For instance, on this line shaft drive, the electric governor permits speed ranges as great as 20 to 1. With the new Type DR turbine, speed ranges up to 5 to 1 may be obtained. However, the standard Type DP turbine (30% range) will meet the requirements of most applications. On this machine you get totally enclosed, hydraulic governing—in addition to many other outstanding features—at no increase in cost.

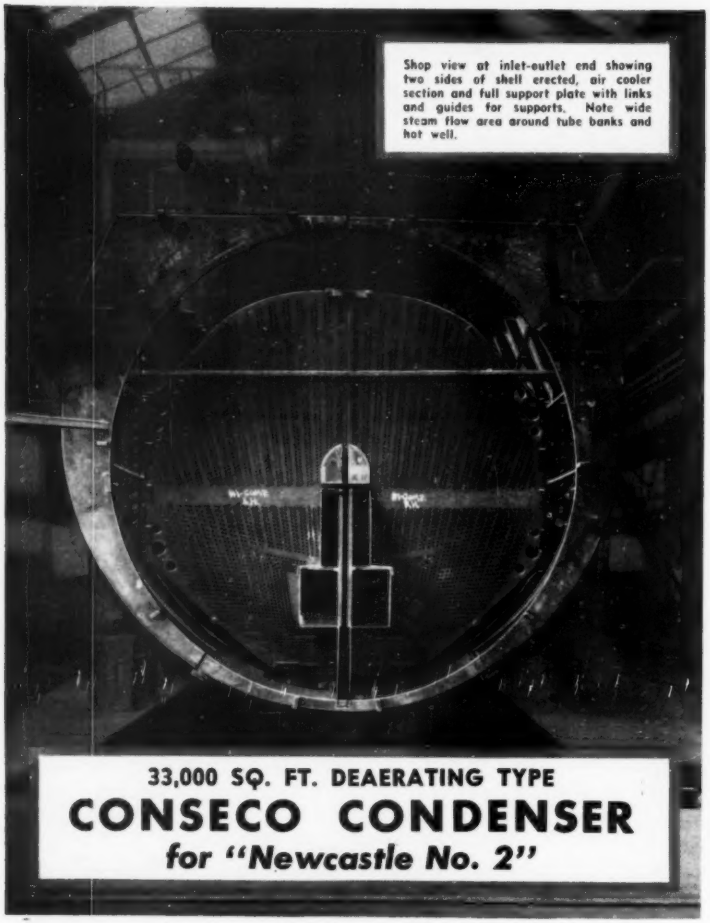


question: Where can I "get the facts" when considering a turbine application? . . .

answer:

Just call or write the nearest G-E Apparatus Sales Office. Your G-E sales engineer will gladly give you complete data on the application of turbines to your mechanical drives—and full information on the many outstanding features *standardized* in G-E turbines. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC



Shop view at inlet-outlet end showing two sides of shell erected, air cooler section and full support plate with links and guides for supports. Note wide steam flow area around tube banks and hot well.

33,000 SQ. FT. DEAERATING TYPE

CONSECO CONDENSER

for "Newcastle No. 2"

Plant: Pennsylvania Power Co., Newcastle, Pa.

Condenser: 33,000 sq.ft., 2-pass, divided flow; 5800 tubes; 1" O.D.; 18 gauge; 22' effective length. Full deaerating hot well .00 oxygen content at all vacua and load conditions. Surface based on tube cleanliness factor of 100%.

CONSECO

PRODUCTS, SERVICES *and* AFFILIATED COMPANIES

Castings and Perforated Metal Products
Pottsville Castings and Machine Shops
Pottsville, Pa.

Boilers and Pressure Vessels
Edgemoor Iron Works
Edgemoor, Del.

Condensers, Evaporators, Heaters, Coolers (All types for All Services)
Condenser Service & Engr. Co., Inc.
Elizabeth, N. J.

Pumps (Plunger and Centrifugal)
Scranton Pump Division
Scranton, Pa.

Heat Exchangers
C. H. Leach Manufacturing Division
Hoboken, N. J.

Unit Heaters
Lee Engineering Co.
Hoboken, N. J.

Steam Engines
The Harrisburg Engine
Hoboken, N. J.
The American Ball Engine
Hoboken, N. J.

Filters and Strainers
Blackburn-Smith Mfg. Co., Inc.
Hoboken, N. J.

Metal Spraying
Molten Metallizing Co.
Hoboken, N. J.

Instrument and Gages
Instrument Service Co.
Hoboken, N. J.

Centrifuges
Centrifuge Mechanical Equipment Co., Inc.
Hoboken, N. J.

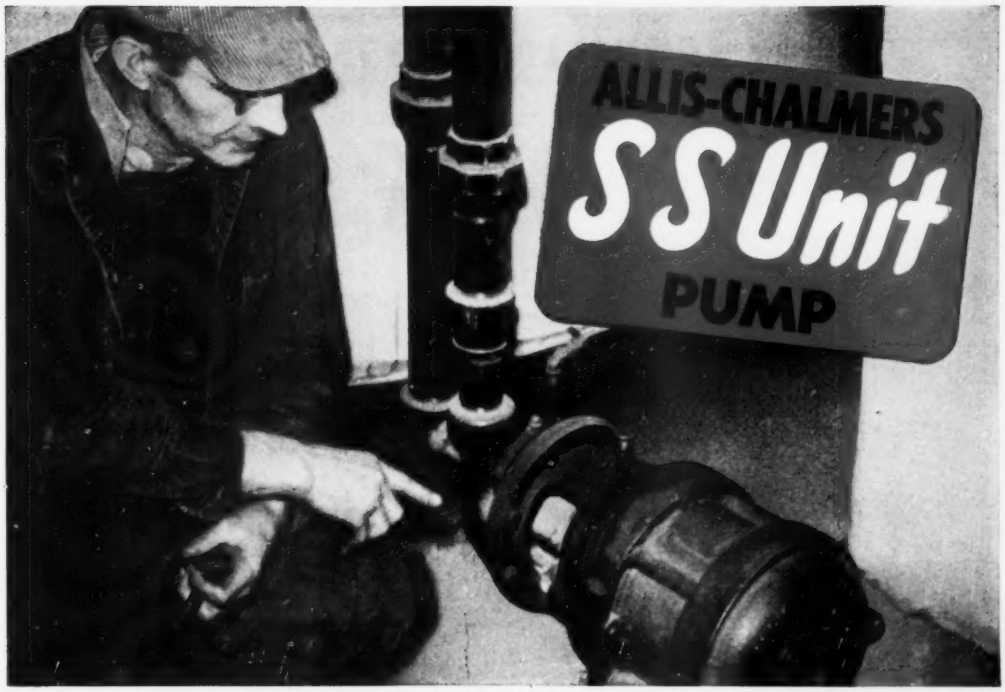
•

The long, specialized experience of CONSECO Engineers, is at your service to help you meet your requirements.

•

CONDENSER SERVICE & ENGINEERING CO.

• HOBOKEN, NEW JERSEY •



7 Years ...NO REPAIRS!

SS Unit Pump on 24 hour, intermittent 7 day duty in power plant gives equivalent of 20 years normal service with *no* repair cost, *no* lost time

SINCE EARLY 1942 this SS Unit pump has been pumping water for the water seal to turbines in the Manitowoc, Wisconsin power plant. Never has it failed to operate perfectly; outside of normal repacking, not one cent spent on repair!

Here's *proof* that the extra-strong design, extra-heavy construction and extra-quality manufacture of Allis-Chalmers pumps give you dependable performance and low pumping costs.

Compare SS Unit features with any similar pump. Notice how SS Unit is compact, yet open for easy maintenance. Motor and pump are solidly bolted together using the same shaft. This design holds alignment rigidly . . . reduces vibration . . . cuts wear and tear. Every A-C pump is tested at the factory. Full rated efficiency and output are *guaranteed*.

SS Unit is one of many Allis-Chalmers pumps for industrial service. For complete information, see your Allis-Chalmers Authorized Dealer or Sales Office, or write for Bulletin 52B6059E. Also in Sweet's.

SS Unit, Texrope and Vari-Pitch are Allis-Chalmers trademarks A-2692

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

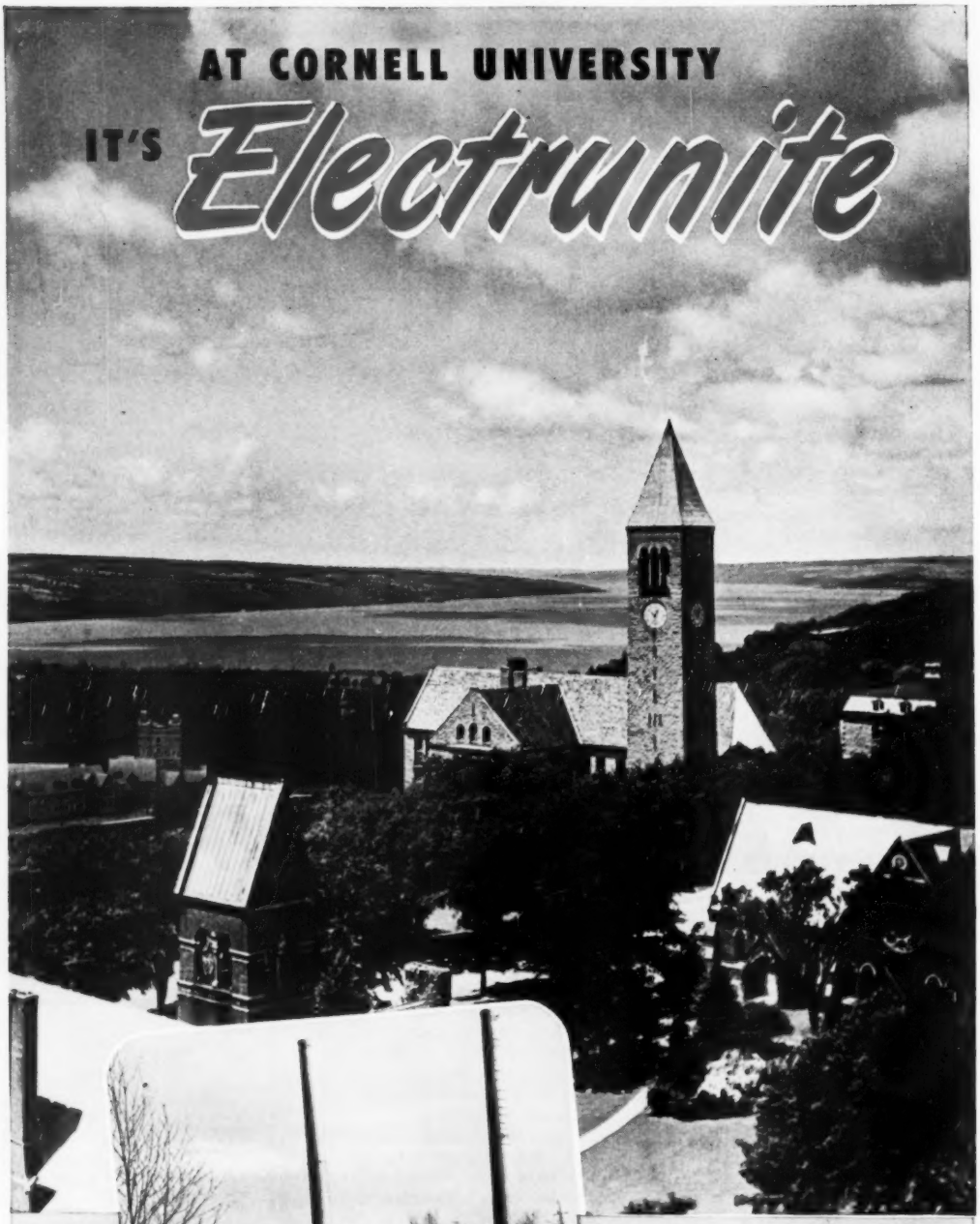
MOTORS — ½ to 25,000 hp and up All types

CONTROL — Manual magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

AT CORNELL UNIVERSITY

IT'S *Electrunite*



Above: A portion of the Cornell University campus, with the Library Clock Tower rising high above the waters of Cayuga Lake in the background.

Left: Exterior of the modern heating plant at Cornell University.

Boiler Tubes

FURNISHING DEPENDABLE, TROUBLE-FREE STEAM IN RECENTLY-COMPLETED RILEY STOKER INSTALLATION

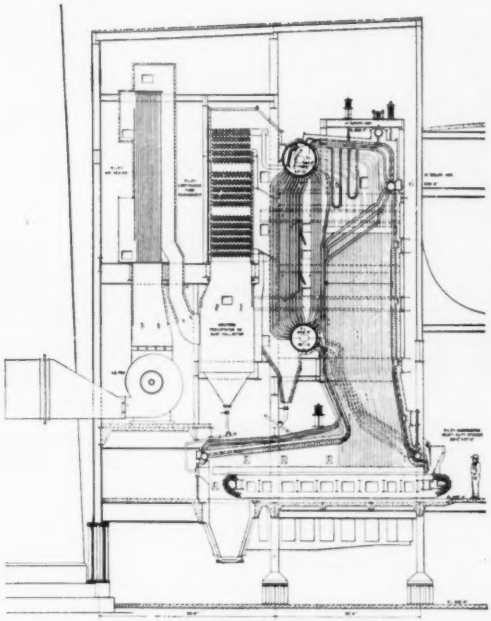
Alma Mater of leaders in every profession . . . subject of a renowned collegiate hymn . . . Cornell University stands high among this nation's educational institutions. And high among Cornell's operating requirements is a dependable supply of steam to heat university buildings during the long, cold northern winter.

Helping to meet these steam requirements are Republic ELECTRUNITE Boiler Tubes installed as original equipment in the new Riley Steam Generating Unit, shown in the diagram at the right. In this, as in countless other installations, ELECTRUNITE Boiler Tubes were specified because of their easy installation characteristics and proven performance records.

Whether you are planning new boiler installations, or specifying replacement tubes for existing units, it will pay you to investigate thoroughly the many time- and cost-saving advantages of ELECTRUNITE Boiler Tubes—resulting from the *improved* electric resistance welding method by which they are made.

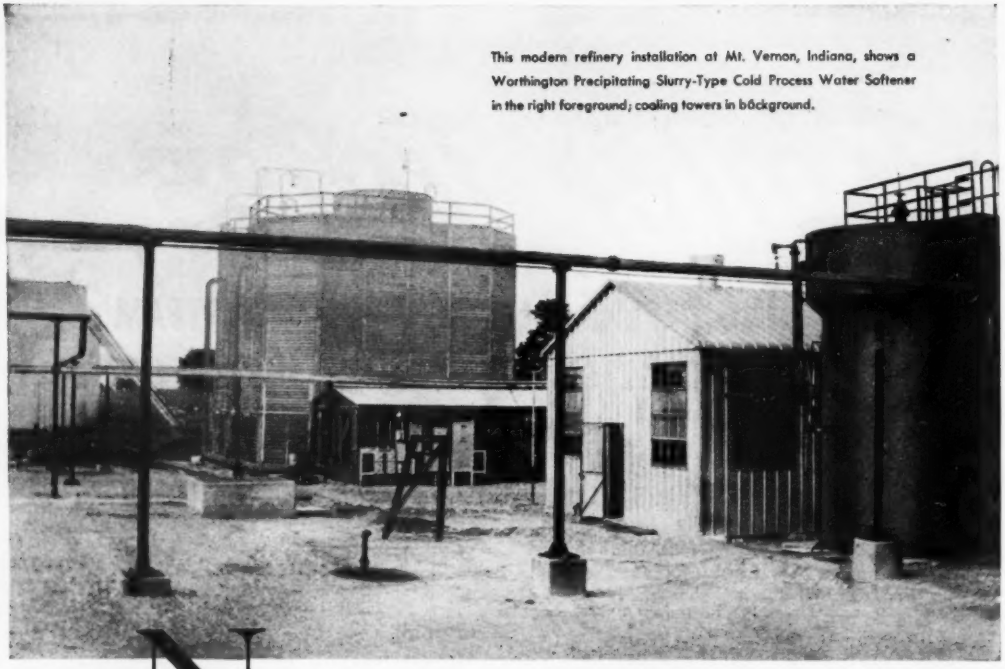
An informative booklet containing the complete story about ELECTRUNITE Pressure Tubes is available upon request. Write for your complimentary copy *today*.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



Containing a total of 42,200 square feet of heating surfaces, this Riley Stoker boiler is designed for ultimate operation at 900 pounds per square inch working pressure, with steam temperatures at 825°F.

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES



This modern refinery installation at Mt. Vernon, Indiana, shows a Worthington Precipitating Slurry-Type Cold Process Water Softener in the right foreground; cooling towers in background.

No other slurry-type cold process softens water this simple way

NO MECHANICAL AGITATION!

This *unique* Worthington Water Softener assures delivery of the uniformly soft, stabilized, clear water needed for scale-free, corrosion-free cooling water systems.

The unique Worthington feature is the scientific use of hydraulic energy provided by the pressure of the general water supply system to maintain the slurry bed. This eliminates the need for moving agitating parts for mixing the applied chemicals with the preformed precipitate.

WHAT'S YOUR WATER TREATING PROBLEM?

The right water conditioning process for one problem may be wrong for another. That's why it pays to call in Worthington, the century-old water-handling equipment maker that knows more about the complicated problems of applying *all four* water conditioning processes than anybody else. Remember, Worthington makes all the essential elements of all kinds of systems. So, by putting complete control and responsibility in the hands of one reliable manufacturer, you can be sure that your water conditioning plant is right for you.

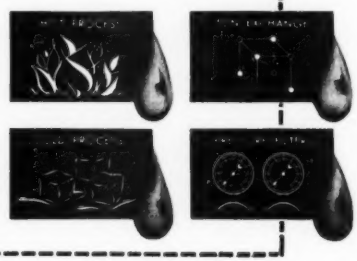
Write today for more information about cold process water softening, and further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*

J8.4

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



SPECIFY ANKORITE SUPER HEAT VALVE DISCS

The problems of your Valve Discs are solved by the adoption of **ANKORITE SUPER HEAT VALVE DISCS** for all Globe and Angle Valves operating on steam, air, water, gas, oils ... and many other services where temperatures run to 400 degrees Fhr.

ANKORITE SUPER HEAT VALVE DISCS are molded from a special compound developed through long research and experiment. This compound will resist the action of heat, oil and solvents, and the age-resisting properties are far superior to any compounds heretofore used in the manufacture of valve discs.

ANKORITE SUPER HEAT VALVE DISCS will not swell or crack under service.

ANKORITE SUPER HEAT VALVE DISCS are made in all sizes for valves ¼" to 24" with round or oval hole.

We shall gladly send full details on request.

BRANCH OFFICES

BALTIMORE, MD.	MILWAUKEE, WIS.
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THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

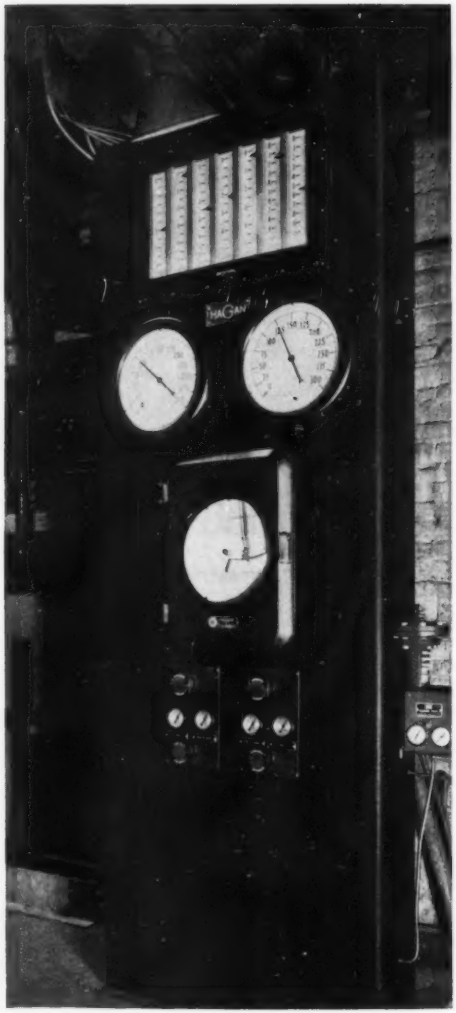
FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

Boiler room modernization includes

HAGAN controls

at WAYNE WORKS



Wayne Works, Richmond, Indiana, is an important manufacturer of school bus bodies and other motor coach bodies of special types.

Steam use in this plant is primarily for the heating of approximately 463,000 square feet of floor space in the various buildings, although a certain amount of process steam is required. Total demand ranges from a minimum of 10,000 lb./hr. to a maximum of 60,000 lb./hr.

To meet increased demand, and also to provide greater economy in steam production, the company has started modernization of the boiler plant. The first step in this moderniza-

← *Hagan Control Panel with Hagan Ring Balance Boiler Meter. Panel is located between new and old sections of boiler room.*

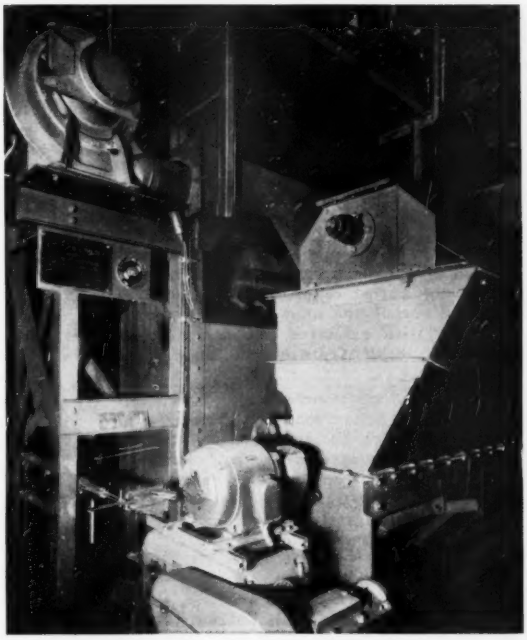
and meters

tion was the installation of a 100 psi, 30,000 lb./hr. chain-grate fired boiler, equipped with Hagan Automatic Combustion Control and Hagan Ring Balance Boiler Meter.

The meter is of the two-pen type, providing a chart record of steam flow and air flow. Steam flow is also shown on a strip indicator.

Since the older boilers which are still in service are manually operated, the advantages of the trouble-free, fully automatic operation of the Hagan system are keenly appreciated by the boiler operators.

For full information on Hagan Controls and Hagan Ring Balance Meters, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.



View of boiler, taken from in front of control panel. Installation was made by Oberle-Jordre Co., of Richmond. William H. Junker of Wm. W. Carleton and Associates, Cincinnati, was consulting engineer. W. H. Treffinger, Plant Engineer of Wayne Works, was in charge of the project.

Bus Bodies like these represent the greater part of Wayne Works production, but special bodies of many types are also manufactured.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

OIC

SETS THE PACE IN VALVES

WITH A *LONG LINE* THAT FILLS YOUR NEEDS

OIC is one of the few producers of a complete line of bronze, iron, cast, forged and stainless steel valves to meet your varied requirements. And OIC Valves are made in one of the most modern valve plants in the country, with exclusive OIC-designed machines that build pace-setting features into every single valve.

Examples?

• Bronze Bonnets of union type construction assure a tight bonnet joint and permit quicker and easier inspection and servicing. • Stuffing Boxes are integral with the bonnet and provide ample packing space. • Large diameter stems are Manganese Bronze. Long sections of accurately cut Acme form threads insure easy operation and long life. • Bronze Swivel Nuts permit the disc to rotate freely on the stem, yet join the two parts securely. • Discs are made of Nickel-Copper alloy, heat treated to a minimum hardness of 300 Brinell.

All these features mean more valve for your money — better service at lower costs!

NO. 552

OIC VALVES

FORGED STEEL • CAST STEEL • IRON • BRONZE

0-749-10

ELIMINATE REPLACEMENT PROBLEMS!

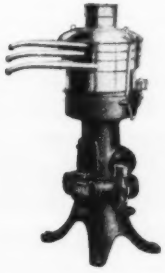
The OIC Cross Reference Chart makes changing over easy. Simply look at the figure number of the valve on the line, check your Chart, and you'll find the correct OIC Valve to replace it. Write for your free copy today!

THE OHIO INJECTOR CO.
Wadsworth, Ohio

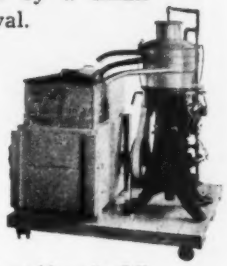
SINCE 1878 ••• DE LAVAL MACHINES HAVE BEEN FIRST

1878 - Carl Gustav De Laval invents the first continuous centrifugal Cream Separator. Tries tubular bowl design.

1879 - Dr. De Laval abandons tubular type bowl for the more efficient wide disc bowl revolving at lower rpm.

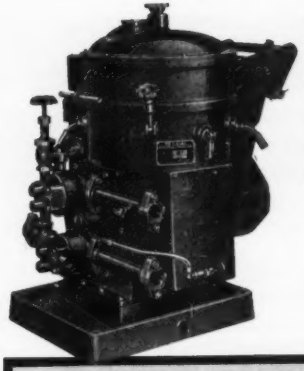


1918 - First centrifugal Oil Purifier introduced by De Laval. This continuous Oil Purifier was driven by a small steam turbine, also invented by Dr. De Laval.



1922 - First De Laval centrifugal Insulating Oil Purifier installed. In 1949, the De Laval method is still the safest way to maintain insulating oil because water, once discharged, cannot recontaminate the dehydrated oil.

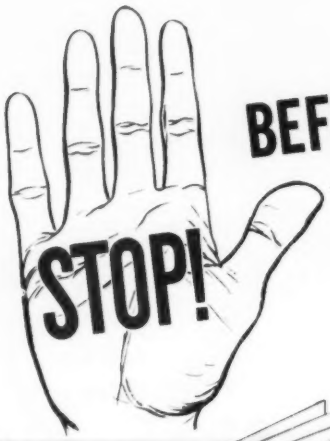
1934 - De Laval introduces its "Uni-Matic," centrifugal Oil Purifier complete with integral pumps and heater.



1949 - New, larger Model 67 "Uni-Matic" with purifying capacity of approximately 450 gph on turbine oil. De Laval, backed by 71 years of experience with centrifugal purification, continues to provide power plants with the means of utilizing centrifugal force most effectively and economically.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL OIL PURIFIERS for more dependable power production



BEFORE YOU BUY ANY STOKER

See this new SPREADER STOKER CATALOG

Don't miss these important highlights !

- 14 Questions you should ask yourself before buying any spreader stoker.
- Shows how to feed wet or dry coal with equal reliability.
- Shows how to distribute coal evenly over entire length and breadth of fuel bed.
- Explains essential requirements of an effective cinder reinjection system.
- Discusses the efficient use of overfire air.
- Completely illustrated with installations featuring these principles.

WRITE FOR YOUR FREE COPY TODAY

AMERICAN ENGINEERING COMPANY
2400 Aramingo Avenue, Philadelphia 25, Pa.

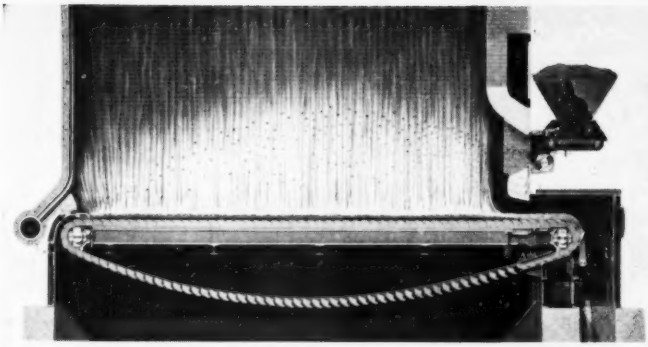
Gentlemen: Please send me a copy of the new catalog of Æ Perfect Spread Stokers. No obligation, of course.

NAME _____

COMPANY _____

STREET ADDRESS _____

CITY _____ ZONE _____ STATE _____



These 4 Spreader Stoker Features Mean Big Savings...

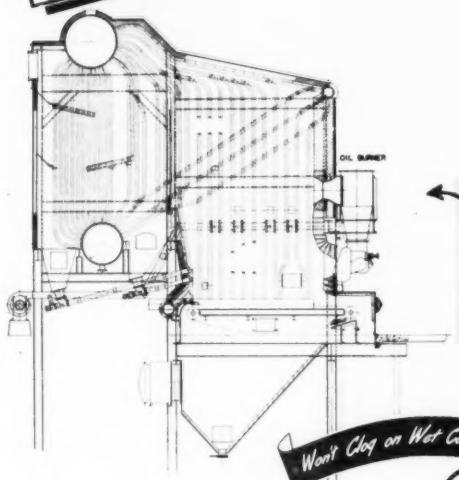
MAKE SURE YOU GET THEM ALL!

INSIST ON:

- Clogless feeding of wet or dry coal.
- Even coal Distribution.
- Cinder Return that Works.
- Adjustable Overfire Air.

Æ Perfect Spread Stokers give you all 4 of the features that mean efficient operation and fuel savings. An exclusive feeder that handles zero to 7500 lbs. of coal per hour without clogging and regardless of the condition of the coal. An overthrow impeller designed, after long research into all types, to spread the coal evenly. Separate cinder return lines run from every cinder drain point to the furnace. Each line is separate . . . cinders air-jet propelled. Overfire air nozzles are individually adjustable.

You'll burn less fuel and generate more steam with an Æ Perfect Spread Stoker. And what you burn can be much lower in grade and therefore less costly. Æ adjustable overfire air and cinder return systems insure efficient combustion, reliable operation and offer better control of stack discharge. Write today for a free copy of illustrated catalog and complete information.



1948 installation in Ohio plant of large industrial company. Two Æ Perfect Spread Stokers with 2 feeder traveling grates. Wickes bent tube boilers. Units have normal capacity of 35,000 pounds per hour each, and a maximum output of 38,500 pounds per hour when burning 10,400 per lb. B.T.U. Ohio coal.

FREE—*Your copy of this informative catalog on Æ Perfect Spread Stokers will be sent you on request. Write. Dept. 10.*

Won't Clog on Wet Coal!

Other Æ Products: Taylor Stokers—Lo-Hed Electric Hoists & Car Pullers—Hele-Shaw Fluid Power—Marine Deck Auxiliaries.

Æ PERFECT SPREAD STOKER

With Traveling, Dumping or Stationary Grates

A PRODUCT OF

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE, PHILADELPHIA 25, PA.

New York Office—75 West Street • Other U. S. offices in principal cities

In Canada: *Affiliated Engineering Corporations Limited, Montreal and Toronto*

FOR

ECONOMICAL-

CONTROL OF

FORCED HOT WATER

HEATING SYSTEMS

USE—

Mastrol

DEPENDABLE, LOW MAINTENANCE COST SYSTEM of Pneumatic Temperature Control FOR SCHOOLS • HOSPITALS • COMMERCIAL, INDUSTRIAL AND APARTMENT BUILDINGS

WITH a Powers MASTROL System of control, comfortable indoor temperatures can be obtained at a low initial cost. Fuel savings alone resulting from elimination of OVER-heating pay back a large return on a relatively small investment.

HOW IT WORKS—The Powers MASTROL system consists of two controllers. The outdoor instrument is the Master control and the indoor hot water controller is the Sub-Master regulator. The master control, conveniently located inside the building, has a thermal system consisting of armored flexible tubing and a sensitive bulb placed on an outside wall. The master control quickly responds to changes in outdoor temperature and pneumatically resets the control point of the sub-master regulator which varies the hot water temperature in direct relation to the outdoor temperature.

Users report "Very Low Maintenance Cost and Dependable Operation". When you want these advantages in a control system for forced hot water heating contact our nearest office or write 2720 Greenview Ave., Chicago 14, Ill.

MA

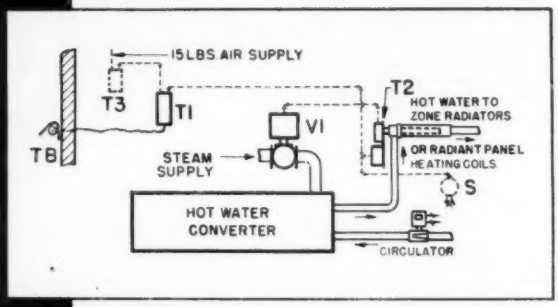
THE

POWERS

REGULATOR COMPANY

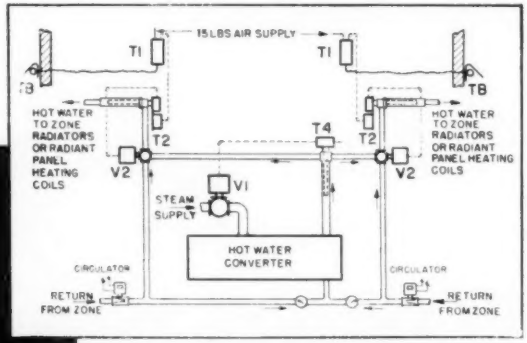
OVER 55 YEARS OF TEMPERATURE CONTROL

Offices in 50 Cities • See Your Phone Book



Above, POWERS MASTROL System Controlling Hot Water Supply for Single Zone with Pilot Room Thermostat. T8-Outdoor thermal bulb and shield. T1-Master control, T2-Sub-master regulator. T3-Pilot thermostat 68°F. for quick warm up (optional). V1-Diaphragm control valve for steam. S-Switch to automatically stop circulator when outdoor temperature is above 60°F., (optional).

Powers MASTROL Control System—One of several combinations of Powers Master-Sub-Master controls for Forced Hot Water Heating Systems.



MASTROL System Controlling Hot Water for Multiple Zones Using 3-Way Water Mixing Valves—T8-Outdoor thermal bulb and shield. T1-Master control T2-Submaster regulator T4-Regulator for Maximum hot water control. V1-Diaphragm Control Valve for steam. V2-Three-way water mixing valve.

Metropolitan Edison Company's

new

Titus Station

at Reading, Pennsylvania

with PIPING and INSTALLATION by SHAW

Benjamin F. Shaw Company is fabricating and installing all the high and low pressure piping for the turbines and boilers and their auxiliaries in this new Metropolitan Edison Company generating station. The initial equipment will consist of two 75,000 KW Turbines connected on a unit to unit system to two 510,000# per hour boilers. Operation will be on a reheat cycle with primary steam conditions of 1450 p.s.i. pressure at 1010° F. total temperature. Gilbert Associates, Inc., Reading, are the engineers.

Benjamin F. Shaw Company is qualified to prefabricate and erect piping throughout the world.

President

BENJAMIN F. SHAW COMPANY

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Wilmington, Delaware

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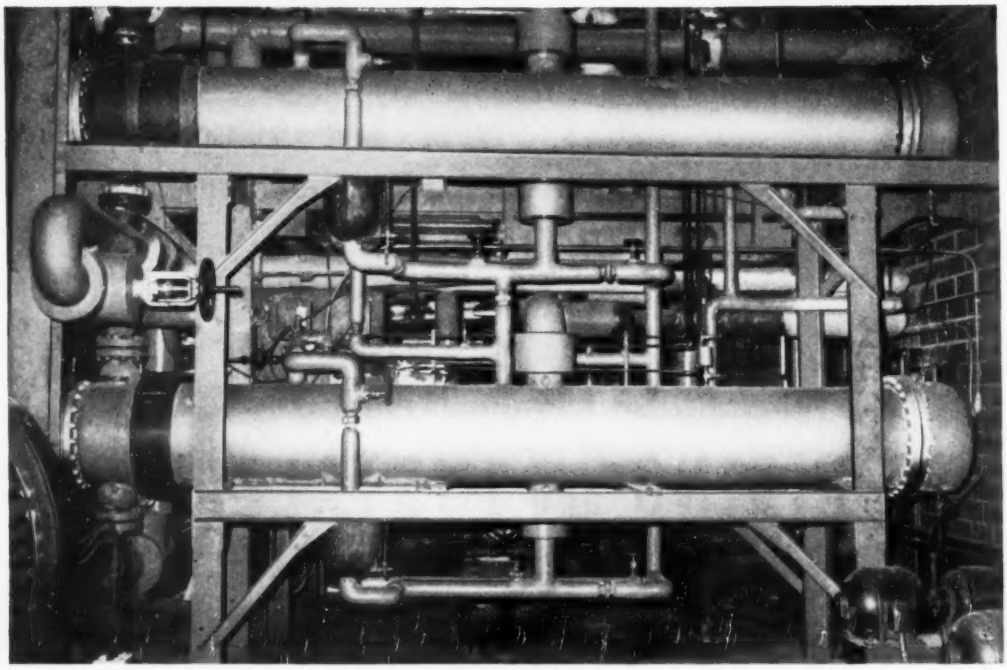

K&M "Featherweight" 85% Magnesia Insulation is used on piping and heat exchangers in this compressor room.

Heat...and cold cash...conserved by

K&M *"Featherweight"* 85% MAGNESIA

Basic Carbonate of Magnesia is combined with Asbestos Fibre in K&M "Featherweight" insulation. Its use on steam pipes and throughout heat exchanger systems is supplying particularly good proof of a whole series of economies that users enjoy...

(1) The highly effective insulation *piles up fuel savings.*

(2) Extreme lightness and easy application *cut installation costs.*

(3) Lasting strength and efficiency mean *freedom from maintenance.*

All this is being demonstrated all the time, in process plants, power plants and on other industrial applications where the heat-saving responsibility belongs to K&M "Featherweight".

You can get K&M "Featherweight" 85% Magnesia in all standard sizes. It is designed for temperatures up to 600° F.

There are K&M Distributors at strategic points throughout the country. They are experts on the application of this and all the other K&M insulation materials. One of them near you can help to make insulation more useful and profitable to you. Or write us.

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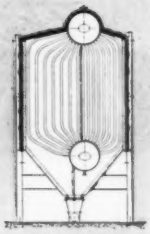
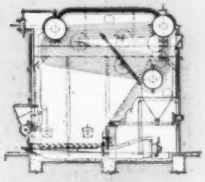
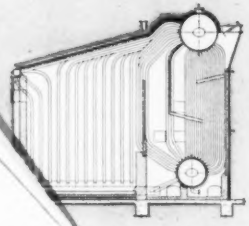
Wickes Steam Generators are in constant daily service in thousands of installations throughout the world. Wickes can fill your exact requirements for boilers of any type up to 250,000 lbs. steam per hour and 850 psi. • Wickes Boilers are engineered for use in oil, chemical, paper and many other industrial uses. Our knowledge of steam generation is available for your consultation, without obligation. Descriptive literature available upon request.



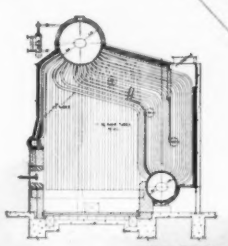
Wickes 2 Drum Waste Heat Installation



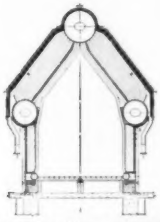
3 Drum Low Head Water Tube Boiler



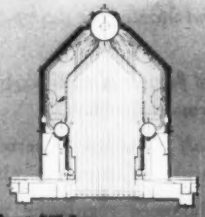
2 Drum Water Tube Boiler



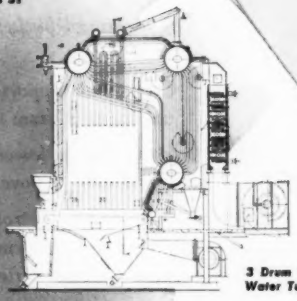
Type-S 2 Drum Boiler Series 51



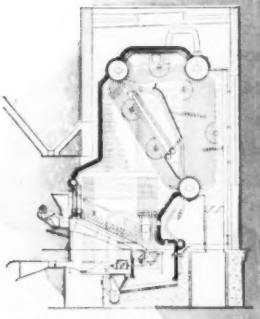
"A" Type Water Tube Boiler



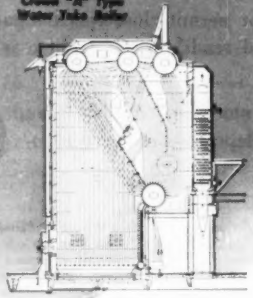
Cross "A" Type Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



3 Drum Water Tube Boiler



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The New

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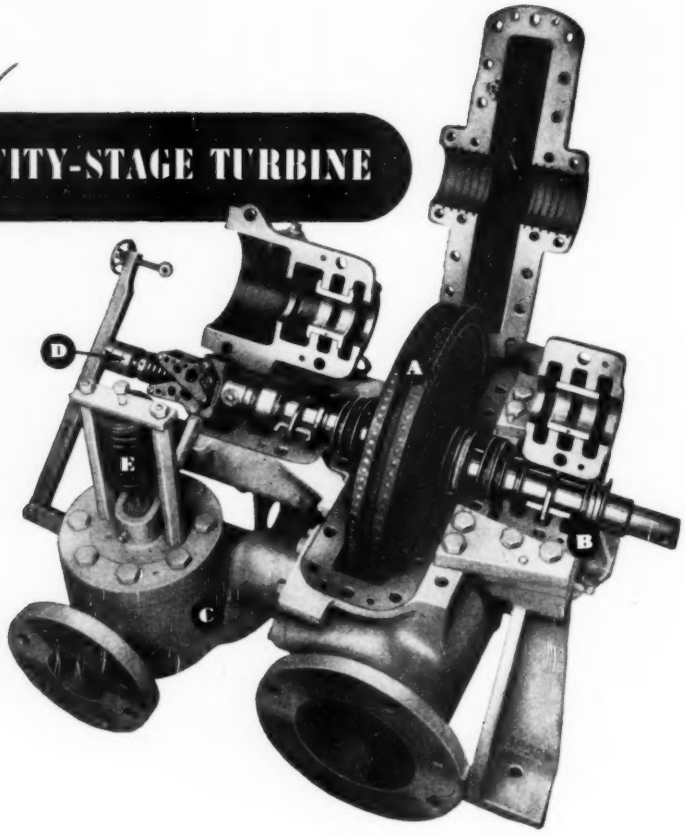

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B *Center line support and flexible mountings,* to avoid misalignment from thermal expansion.

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D *Improved speed control.* Balanced regulating valve and direct acting governor permit close speed regulation. Speed can be varied readily while turbine is running.

E *Separate trip mechanism* and emergency closing valve, operated by speed governor independent of speed regulating valve.

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POWER

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JULY 1949 • VOL. 93 • NO. 7

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PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
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TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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Cover photo: Skilled mechanic at Westinghouse Electric Corp's East Pittsburgh plant aligns commutator necks of rotor for 7000-hp electric motor.

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LIFE-LINE

slashes a-c motor upkeep costs

Here's how Life-Line motors can save you half the upkeep cost, and more.

A recent survey of 114 large motor users—operating 131,626 a-c motors of 1 to 50 hp—shows how much motors *really* cost when you figure actual "Life Cost".

The survey shows that the yearly average cost of periodically lubricated motors was $270 for every hundred motors installed.

On lubrication cost alone, Life-Line motors saved this $270. That's because Life-Line requires no periodic lubrication—no added lubrication of any kind.

The survey also indicates that the yearly outage cost per hundred motors, for repairs and lost machine and man-hours, was $960.

The record of 500,000 Life-Line motors in service, to date, indicates a failure rate averaging less than half that of conventional motors covered by this survey. This means over 50% indicated reduction in motor outage costs—in short, a possible saving of $480 per year with Life-Line.

Add these savings—$270 for lubrication plus $480 for outages—and the result is $750 per hundred motors per year.

Can you afford to pass up savings like these? Get the facts on the savings possible in your plant. Ask your nearby Westinghouse representative for a copy of B-4321 "How to Cut Motor Costs $750". Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

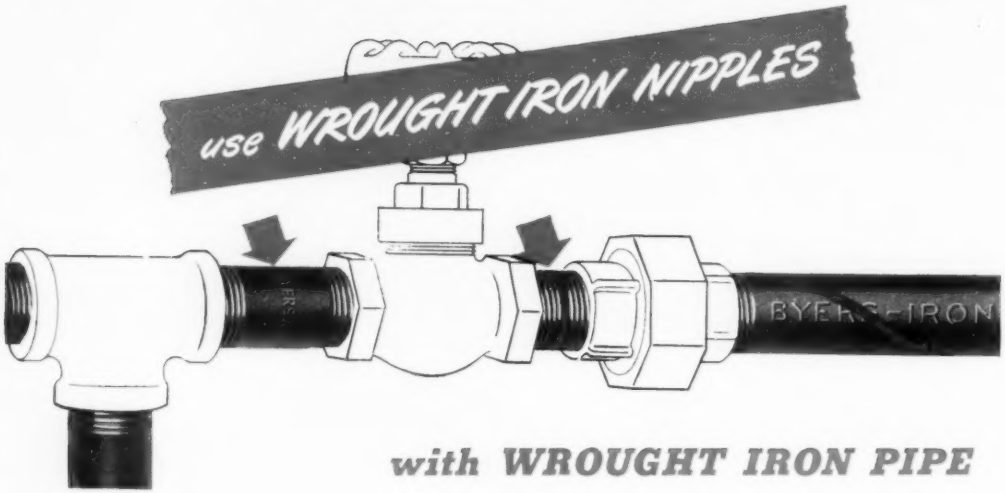
J-21508-A

Westinghouse

Motors

SAVING
BY ELIMINATING LUBRICATION
$270
SAVING INDICATED
BY REDUCTION OF MOTOR OUTAGES
$480
TOTAL SAVING
PER YEAR PER 100 MOTORS
$750
DO NOT
LUBRICATE

Avoid "Weak Links" in your piping systems—



with WROUGHT IRON PIPE

When you specify wrought iron pipe to lick some corrosion problem, assure 100% protection by specifying that the pipe nipples also must be wrought iron. Neglect of this simple precaution will leave weak spots in your lines, and set the stage for maintenance headaches.

METHOD OF SPECIFICATION

Merely stating that the piping "system" is to be black or galvanized wrought iron is not enough; the use of wrought iron nipples should be specifically designated. This may be done by requiring that the wrought iron nipples shall be made of pipe conforming to the requirements of A.S.T.M. Specification A72-45, Federal Specification WW-P-441a, Navy Specification 44P11k, or any accredited proprietary specification.

WIDE RANGE OF SIZES

Byers Wrought Iron nipples, both standard weight and extra strong, are available in a wide range of sizes and lengths, either black or galvanized. They are manufactured from new, tested, full-weight wrought iron pipe in accordance with the standards established in the specifications of leading technical organizations. All nipples are furnished with right-hand threads unless otherwise specified; nipples with right and left-hand threads are also available. Nipples are furnished "close" or to length as specified.

IDENTIFICATION

The word "Byers" and the weight —either "Std." or "X Stg." are machine stamped around the circumference of Byers Wrought Iron nipples. On close nipples, where it is impractical to stamp on the threads, a red band is used. These markings provide quick, positive identification of Byers Wrought Iron nipples, and help to avoid any danger of accidental substitution of non-durable nipples in the line.

IN WELDED SYSTEMS USE WROUGHT IRON WELDING FITTINGS

Wrought iron welding fittings are available in a wide range of types and sizes from leading fitting manufacturers. Just contact your supplier.

Wrought iron nipples are also available from a number of manufacturers. The identification used on such nipples may be learned by consulting the supplier.

INHERENT CORROSION RESISTANCE

The superior resistance of wrought iron nipples comes from the unique composition and structure of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and "detour" corrosive attack, and so discourage pitting. The fibers also anchor the initial protective scale, which shields the underlying metal.

The best guide in applying wrought iron is a knowledge of its character and properties. The complete story is presented in the booklet, "The ABC's of Wrought Iron". Ask for a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N.Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

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GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • JULY 1949 • ESTABLISHED IN 1882

Manpower Costs $15 per Kwhr

BACK IN JANUARY we said that you can now buy 1000 manpower for one worker's wage. Here's the proof: Hour for hour the average wage will buy 100 kilowatts of electric power. That will run a 100-hp motor at full load. Multiply this by ten, because each motor horsepower will turn out more work than ten sweating laborers armed with pick, shovel, wheelbarrow or other hand implement. So the motor powered at the cost of one man's wage will do the physical work of 1000 men.

Now, maybe, in some regions where wages are low or industrial rates are high, the wage won't quite buy the 100 kilowatts. Even so the thousand-to-one ratio still holds by a wide margin, for one tenth horsepower per worker is a *top* figure. The national average for heavy labor is closer to one thirtieth of a horsepower.

By the same line of reasoning you can prove that you must pay men at least fifteen dollars to turn out as much mechanical work as one kilowatt hour can deliver. That is, you pay around $1.50 per hour for less than a tenth of a kilowatt. To put it bluntly, manpower costs you $15 *plus* per kwhr, which should be food for thought, and reason for action.

Some will object that this statement is one-sided: "You get a lot more than raw power when you hire a man. For one thing, he brings along his own motor and controls." And they remind you that the employer buys experience, skill, intelligence and loyalty—values that won't flow through wires.

True enough; you get all these plus values when a man works for you. In fact, he is really hired for these values. But once he is on the payroll the boss too often uses the employe's costly muscle power to push a file, pull a saw, swing a paint brush, or heave weights, even though every one of these jobs would be duck soup for some gadget powered by low-cost electrical energy.

"Don't hire a boy to do a man's work," they say. Here's a better one: "Don't hire a man to do a motor's work." But do we?

Admittedly America has mechanized tremendously. In the home the sewing machine has been followed by a whole string of powered labor savers—refrigerators, vacuum cleaners, polishers, mixers, power lawn mowers and hedge trimmers.

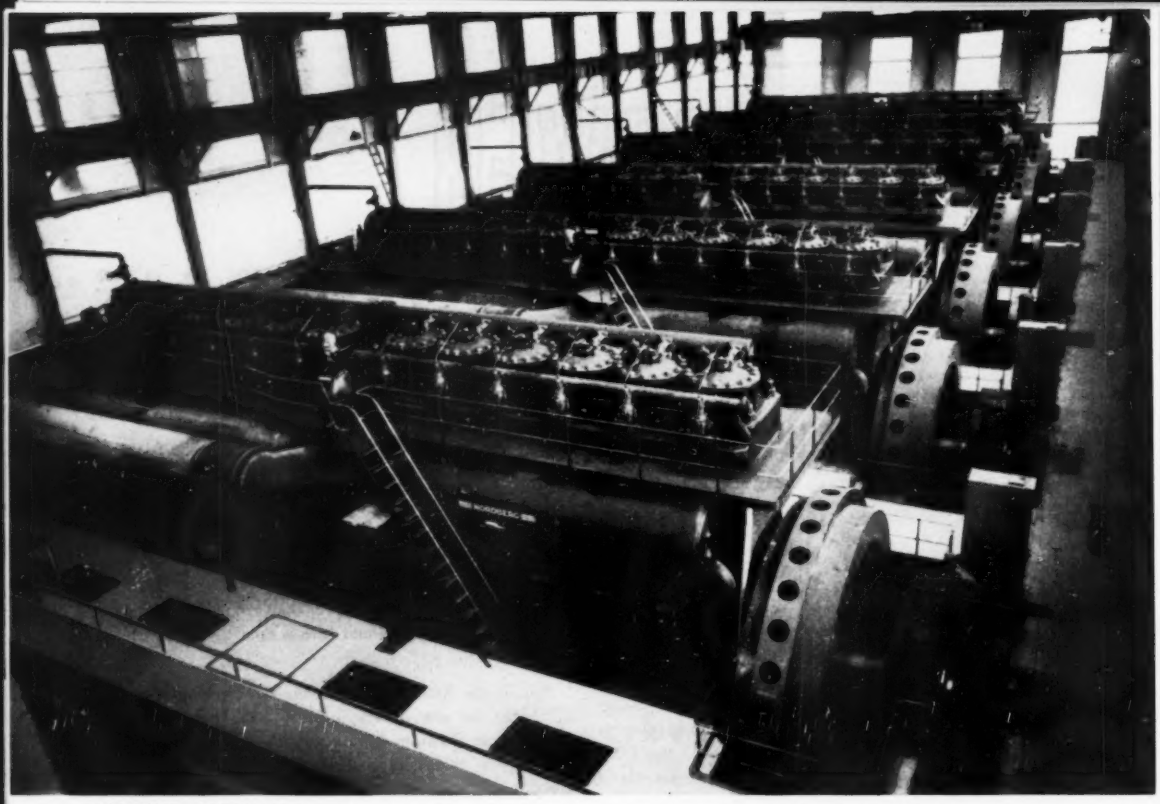
On the farm the energy of petroleum plows the land. Electricity, more and more, pumps the water, milks the cows, and saws the wood.

In up-to-date factories the productive machines are served by a multitude of power hoists, trucks, stackers and conveyors. And in the power plant itself fuel handling and burning, and ash removal, are usually mechanical.

So today we must grant that the big energy-using jobs almost everywhere are electrically and mechanically powered—and that's why today's Americans live better than any other people in any age. Just the same, there's room for all of us to go a lot farther in practical mechanization.

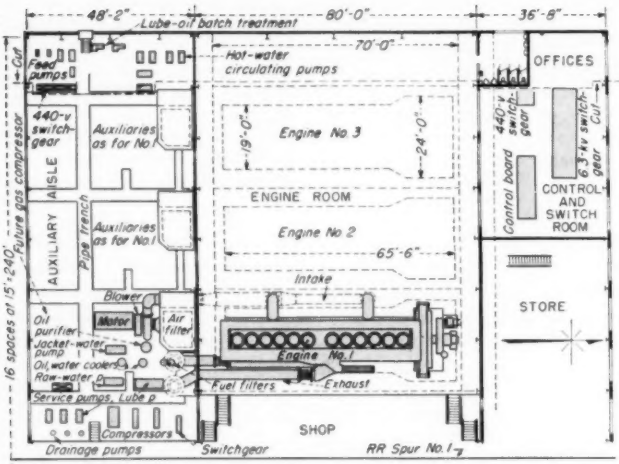
Test this in your own plant: Particularly look at those fringe jobs—small construction projects, maintenance, steam fitting, painting, boiler cleaning, etc. Do you see any hand tools being worked at $15 plus per kilowatt-hour? Is it necessary? How long would it take for this extravagance to pay for a good power drill, a motor-driven pipe threader, a power hacksaw, a paint sprayer or some other power-driven work unit?

Why don't we all worry less about how hard men work and more about how much they get done? Low-cost inanimate power for almost every job is the sure road to better living and less sweat for everybody.



ENGINE-GENERATOR SETS consist of 12-cylinder 29x40-in. 2-cycle diesels driving 7500-kva 0.8-pf 167-rpm generators

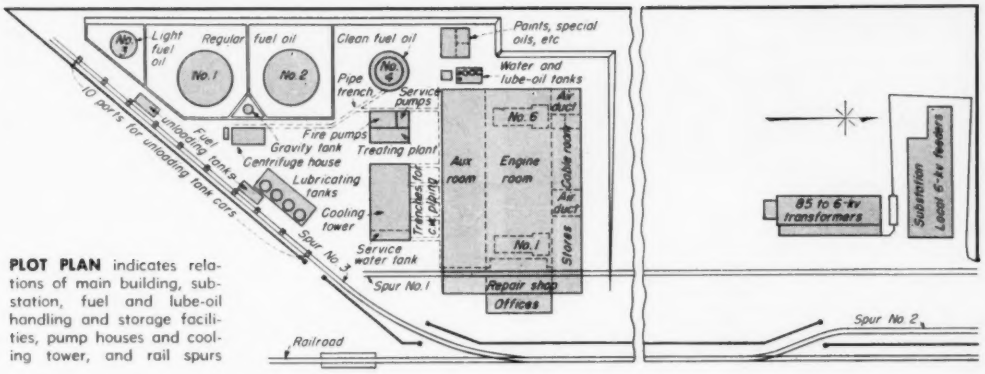
Tacubaya, Largest Diesel Plant, Adds



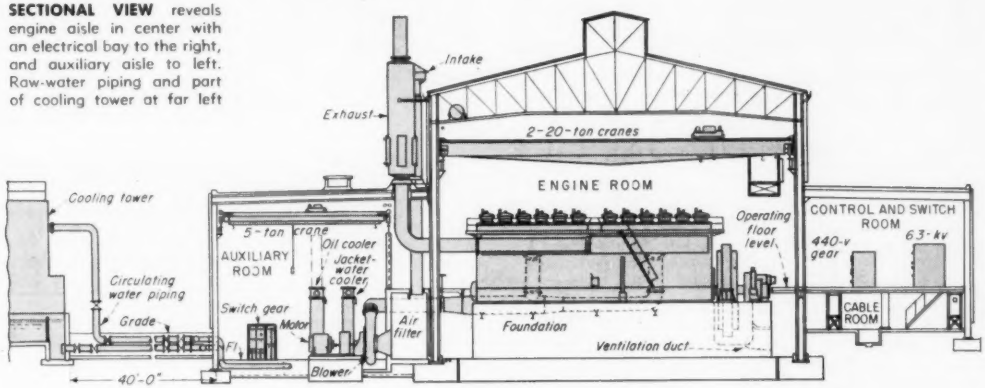
PARTIAL PLAN shows main units with engine auxiliaries grouped south of each, plant auxiliaries at ends of aisle. Shop with rail spur at east end

Station built in 18 months meets rapidly growing demand in Mexico City area. Engines are largest yet built in the U. S.—8650 hp each. Design marked by sound engineering, use of heavy fuel

► THE LARGEST OIL-BURNING diesel plant in the Western Hemisphere, and possibly in the world*, is now operating at Tacubaya, a growing industrial suburb of Mexico City. With six diesel-electric sets of 5150-kw each, it adds 30,900 kw to the system of Compania Mexicana Meridional de Fuerza. This is a subsidiary of the Mexican Light & Power Co, which has been operating



PLOT PLAN indicates relations of main building, substation, fuel and lube-oil handling and storage facilities, pump houses and cooling tower, and rail spurs



SECTIONAL VIEW reveals engine aisle in center with an electrical bay to the right, and auxiliary aisle to left. Raw-water piping and part of cooling tower at far left

30,900 Kw to Mexican Power System

By J K JENNINGS, *Chief Mechanical Engineer, Mexican Light and Power Co, Ltd*

in Mexico for more than half a century and has played no small part in the industrial progress of that country.

Existing System. The system to which the Tacubaya plant connects supplies electric energy to the central plateau of Mexico and extends from the Gulf Coast oil fields well into the State of Guerrero on the Pacific Coast. It supplies the important silver-mining area of Pachuca, as well as the rapidly growing needs of Mexico City itself. Other plants of the system include 15 hydroelectric stations encircling the central plateau, the largest having a capacity of 100,000 kw, and the 80,000-kw Nonoalco steam station in Mexico City. With the interconnected 56,000-kw hydro station of the Federal Electricity Commission, installed system capacity approaches 390,000 kw. On this system, the new diesel plant is being operated as a base-load station.

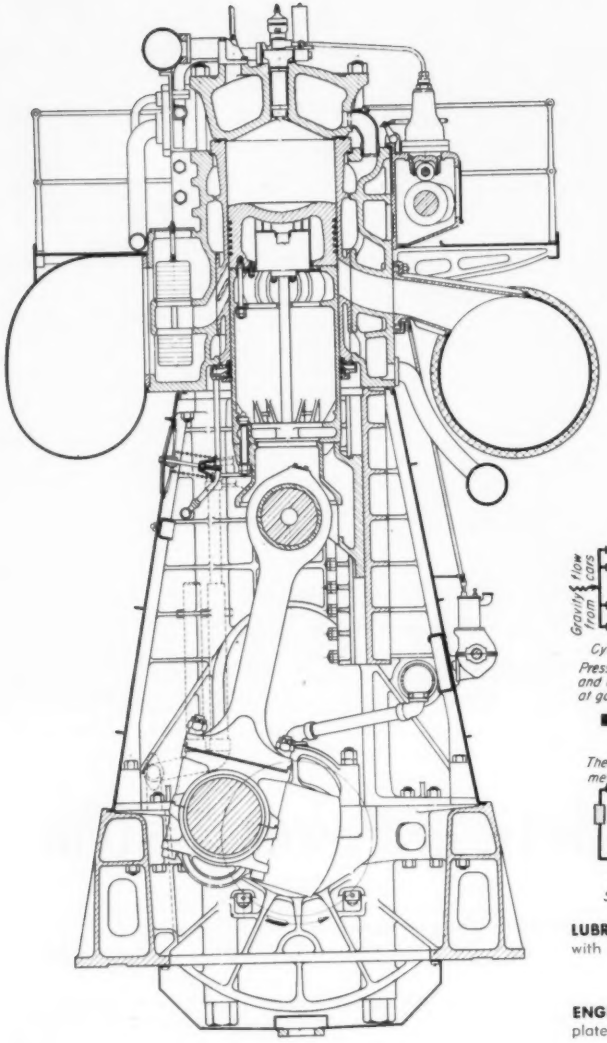
Urgent need for increased capacity to meet the extraordinary increases in demand, which have characterized this area for several years past, led to decision to install this diesel plant. It is worthy of note that ground was broken at Tacubaya in Dec 1947; the first unit went on the line in Nov 1948; the remaining five units were placed in service at the rate of one per month.

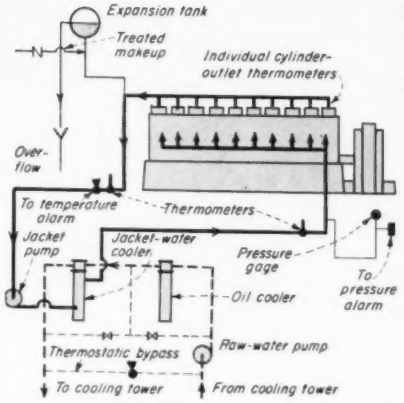
Heavy Fuel Used. Special interest attaches to the plant because of the size of the units, largest yet constructed in the U. S., and because design is for Mexican fuel oil of the bunker-C class. Provision has been made for natural-gas fuel, which may be available later. Engineering staffs of Mexican Light & Power Co and Nordberg Mfg Co collaborated in design of the installation.

The site chosen, which the company already owned, contained a 50,000-kva substation fed from the 85-kv ring encircling Mexico City. This fact, plus good rail access for fuel-oil transportation and satisfactory subsoil properties, made Tacubaya ideal. Arrangement of buildings and equipment on the roughly triangular plot is shown in the plan above.

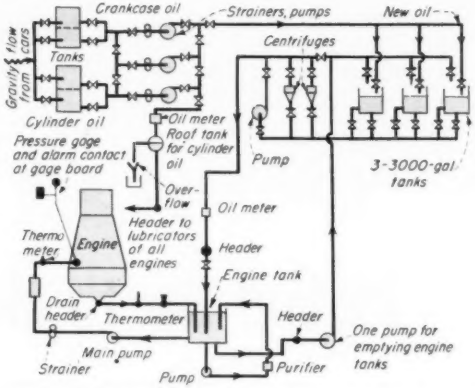
Building Design. Layout of the main building housing engines and auxiliaries is revealed in the section (above) and the partial plan (facing page). Of steel framing with brick panels and asbestos-cement-sheet roof, the main building is notable for excellent lighting provided by large window areas along side walls and four rows of skylights in the main-aisle roof.

*For diesel-plant size comparisons, see "Speaking of Power," p 102.





COOLING-WATER circuit for each engine is independent and closed, automatically controlled



LUBRICATION SYSTEM provides continuous bypass treatment with fuller's earth, batch removal for centrifugal separation

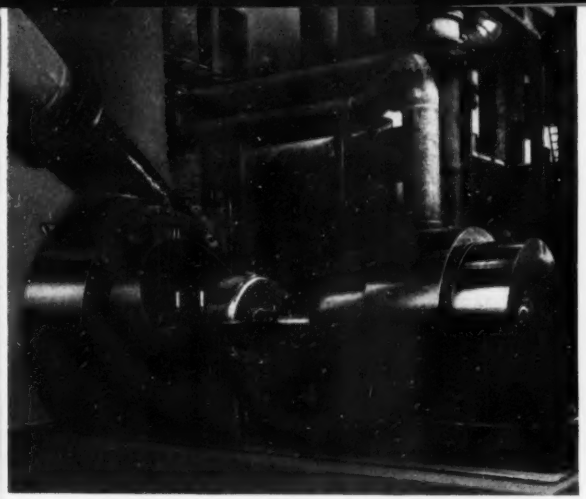
ENGINE SECTION shows crosshead design. Tierods connect bedplate and cylinder block, take all firing-pressure stresses

Central and largest aisle contains the six engine-generator sets. One side aisle houses engine and plant auxiliaries, the other control room, stores and offices. Two 20-ton traveling cranes serve the main aisle, which is 80 ft wide and 69 ft 9 in. from grade to top of roof monitor. The 240-ft length divides into sixteen 15-ft bays: the six engines stand on 30-ft centers, with three 15-ft bays at one end serving as a repair shop. A rail spur runs across this end, making it possible to unload cars with the main cranes.

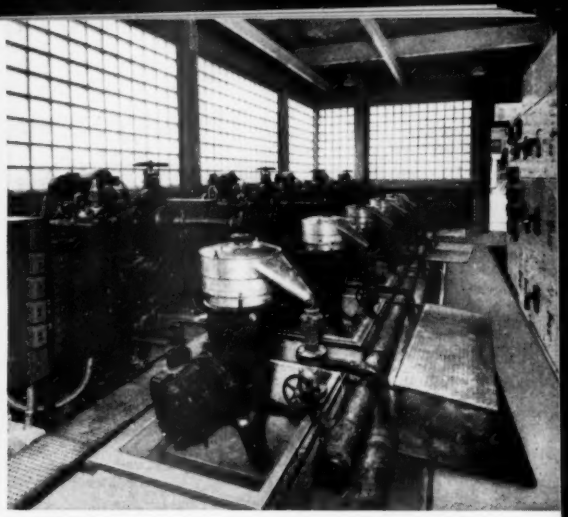
The south, or auxiliary aisle, is 48 ft wide, served by a 5-ton traveling crane. Engine auxiliaries, including large scavenging blowers, stand along this aisle, with general plant auxiliaries (starting compressors, service-water and hot-water pumps, lube-oil handling and purifying equipment, etc) at each end. Metalclad switchgear for auxiliary control also stands in this aisle, each panel group being within easy view of corresponding equipment. Spaces remain for individual gas compressors for each engine. These will be needed for gas operation.

Ventilation. The switch and control room, in the central part of the north aisle, at engine-operating floor level, affords a good view of the engine room. Below the control room is a cable room with floor at grade. Main air ducts enter at either side of cable room. These ducts, 30 ft wide by 8 ft high, communicate with the engine-aisle basement. They supply fresh air to generator pits and to gratings in the operating floor between each engine, for general engine-room cooling. Natural draft now provides the ventilation, but layout permits forced ventilation with air washing if it should prove desirable.

Engine-Generators. The six Nordberg 12-cylinder 29x40-in. 2-cycle mechanical-injection engines drive General



SCAVENGING BLOWER, centrifugal type, is driven by 1000-hp motor. Oil cooler and heat exchanger can be seen in rear



CENTRIFUGE HOUSE has five sets of heaters, filters and separators, each able to handle 1000 gal of fuel oil per hr

Electric 7500-kva 0.8-pf 6.3-kv generators. At rated speed, 167 rpm, these engines carry a sea-level rating of 8650 hp. Since the plant is 7500 ft above sea level, corresponding full-load rating would be 6680 hp, if derated to DEMA standards. Using the centrifugal scavenging blowers to slightly supercharge the engines increases output approximately 10% to 7350 hp.

Construction Features. A cross section through one of these crosshead-type port-scavenging engines appears on the facing page. Ribbed bridges in the cast-iron bedplate support 2-piece removable-shell main bearings with centrifugally cast linings. Main bearings are 22 in. in diameter. One thrust-collar locates the forged 2-section crankshaft, which has integral thrust collar and coupling flanges. The gear driving the camshaft train is at the coupling between these sections. Crankshaft weighs 57 tons, exactly one ton per ft of length.

An unusual generator construction insures maximum stiffness with the long crankshaft. Instead of the conventional hub, pressed on the generator shaft, the generator rotor disk, without a hub, clamps between engine-shaft flange and extension-shaft flange, held by fitted bolts. This design made it unnecessary to ship the extension shaft to the generator builder for assembly.

Frame Design. Engine frames consist of "A" columns straddling each main bearing and supporting the cylinder block. Tierods anchored in the bedplate, and extending through frame-column legs to nuts above the cylinder block, take all gas-pressure stresses. A special hydraulic-jack assembly stressed these tierods to accurately predetermined limits.

Power piston heads are oil cooled and grooved for six rings. Trunks bolt directly to crossheads. They are easily removable for cylinder inspection. Alloy-cast-iron cylinder liners carry scavenging and exhaust ports, the former having check valves to assure uncontaminated scavenging-air supply. A multifeed timed lubricator supplies lube oil to the upper end of each cylinder, at seven points around the liner. Consumption of cylinder oil runs about 2 gal per cylinder, per day.

Lubrication. On each engine, an independent motor-driven 1100-gpm oil pump takes suction from a 3000-gal sump tank and delivers oil at 40 psi through a duplex basket strainer to the cooler and thence to a header in the crankcase. This header connects to each main bearing. Drilled passages in crankshaft and connecting rods lead oil to wristpin bushings and piston heads for cooling. Piston-cooling oil returns through telescopic pipes to the bedplate and thence to the sump tank for recirculation. Each piston-oil return has its own thermometer.

Lube oil is treated by both continuous and batch methods. Fuller's earth bypass filters for each engine treat oil continuously at the rate of 10 gpm. At the west end of the auxiliary aisle stands equipment for batch removal and treatment of engine lube oil. This consists of two centrifuges, three storage tanks and necessary pumps.

Injection System. An independent injection pump, camshaft actuated, serves each power cylinder. Each has a hand-priming device, and can be cut in or out of operation while engine is running. Developed by American Bosch Corp. in collaboration with Nordberg, injection pumps and nozzles are the largest of their type. They were developed especially to handle heated heavy fuel oil. Injection is controlled by hydraulic governors with manual and remote speed adjustment. Speed-droop and load-limit controls are also provided.

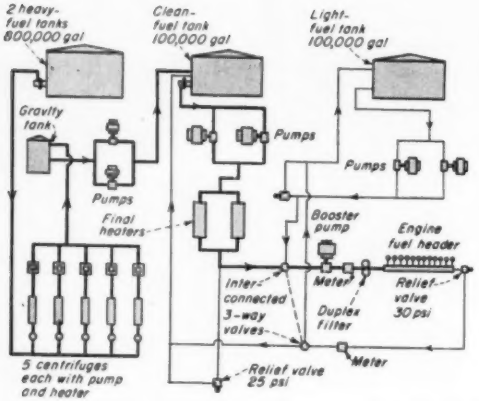
Instrumentation. For safe and efficient operation, each engine gage-board contains: (1) pressure gages for starting air, lube-oil pressure before and after cooler, raw-water and jacket-water pressure, and fuel-oil pressure before and after filters (2) blower-motor loading ammeter (3) multi-point exhaust pyrometer showing temperature from each cylinder and in each of the two manifolds (4) kw indicator showing load on unit.

Visible and audible signals give alarm in case of: (1) low lube-oil pressure (2) high lube-oil temperature (3) low jacket-water pressure (4) high jacket-water temperature (5) overcurrent to blower motor (6) failure of lube-oil pressure to blower. Horn alarm sounds if operator attempts to start engine under any but proper conditions.

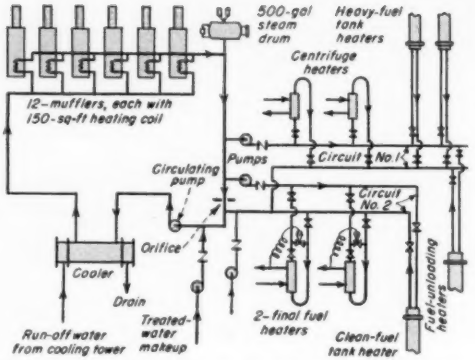
If an engine in service suffers overspeed, failure of lube-oil or scavenging-air pressure, a spring-loaded device releases, turns fuel-regulating shaft to "no fuel" position, and simultaneously trips the main generator switch. This separates the generator from the system and stops the unit.

Starting System. Cam-operated air-admission valves supply starting air to all cylinders. Interlocking the starting lever and the barring gear for turning the engine when out of service prevents admission of starting air if barring gear is engaged. The two motor-driven starting-air compressors operate at 250 psi.

Scavenging Air. A blower rated at



FUEL-OIL SYSTEM provides for heating and centrifuging fuel oil of bunker-C type; light oil is used for starting engines



FUEL-HEATING SYSTEM operates under pressure. Exhaust heat raises temperature of water circulating in heaters to 240 F

45,000 cfm, 3.6-psi total pressure rise, supplies each engine with scavenging air. Each blower's 1000-hp squirrel-cage motor connects directly across the corresponding generator terminals. During startup, blowers are brought up to speed with generators by energizing main-exciter fields by storage battery. Scavenging air, from silenced inlets on the auxiliary-aisle roof, is filtered by automatic self-cleaning units.

Cooling System. A 2160-gpm raw-water pump for each unit discharges through the oil cooler and jacket-water heat exchanger in series. Engine jacket-water systems are independent and closed. Special feed pumps maintain proper level in expansion tanks located in roof trusses. Jacket-water pumps circulate 2160 gpm through each engine and its heat exchanger. A thermostatic valve acting on a bypass in the raw-water circuit holds water temperature leaving engine to 140 F.

Redwood cooling tower in the raw-water system has three sections and six induced-draft fans, each driven by a 15-hp motor. The tower is designed to cool 13,000 gpm from 110 to 90 F with maximum wet-bulb temperature of 70 F. Built over a concrete sump tank, the tower stands on the south side of the engine building. Tank elevation is enough to ensure a small head at raw-water-pump inlets under all conditions.

Water Supply. Two wells on the property supply water for cooling-tower makeup and other services. These have 12- and 14-in. casings and are about 750 ft deep. Static water level lies about 180 ft below grade; two 750-gpm deepwell pumps raise water. Operation is automatic, depending on water level in cooling-tower sump and adjacent service-water tank.

This well water shows the following properties:

Total alkalinity (All bicarbonate)	85	ppm as $CaCo_3$
Total hardness (All temporary)	47	" " "
Calcium	25	" " "
Magnesium	0.56	" " "
Sodium and potassium	50.3	" " "
Silica	55.4	ppm as SiO_2
Chlorides	3.5	ppm as Cl
Sulphates	8.4	ppm as SO_4
Total solids	159.2	ppm
pH	6.6	

Water Treatment. Raw water circulating between cooling tower and heat exchangers is treated with 3 ppm of Calgon to control scaling in exchanger tubes. It is also chlorinated once per shift up to 6 ppm to prevent algae growths, which cause rapid tube fouling in Mexico City. Runoff from cooling tower is adjusted to limit total alkalinity in circulating water to double that of makeup or well water.

General service water for the plant comes from a 10,000-gal concrete tank adjacent to the cooling-tower sump, at about grade level. Three 150-gpm 25-psi pumps maintain service-water supply throughout the plant. There is no elevated tank at Tacubaya.

Makeup for the jacket-water system of each engine, and for the hot-water fuel-heating system, comes from the service supply. An 11-gpm zeolite unit softens the makeup, which is further conditioned with caustic soda to yield a pH of 9.5. For inhibiting corrosion, 300 ppm of sodium chromate is also added. Treated-water storage tanks have capacity enough to replace the water in one engine.

Fuel System. Tank cars deliver fuel oil, coming in on spur No. 3, which runs along the southeastern boundary wall of the property. Ports spaced between the tracks permit unloading ten cars at one time. At continuous full load the plant consumes over five cars of fuel daily.

Regular bunker-C fuel is pumped into two storage tanks of 800,000-gal capacity each. Light fuel for starting, and lubricating oils, can also be received by tank car at the same spur and pumped into their respective tanks.

Average characteristics of fuel received from the Gulf Coast are:

Specific gravity at 68 F	0.98
Flashpoint, F	230
Viscosity, furol, at 122 F	200
Viscosity, universal, at 212 F	160
Conradson carbon	11%
Sulphur	3.2%
Hard asphaltum	Nil
Heating value, Btu per lb	18,500

This fuel is heated to about 210 F to obtain desired viscosity of 125-175 ssu at the fuel-injection nozzles.

A separate building (marked "centrifuge bldg" on the plot plan) houses equipment for fuel-handling and cleaning. Unloading and transport pumps are in the basement, and five groups of hot-water and electric fuel heaters, filters and centrifuges, each of 1000-gph capacity, are on the upper floor. Diagram above shows hookup for handling heavy and light fuel.

Means are provided for purging the filters and cleaning the centrifuges, and for easy disposal of the impurities removed from the fuel. From centrifuges, fuel goes to a 100,000-gal service tank. Here it is held in readiness for final heating and delivery to headers running the length of the plant. Fuel booster pumps of each engine take suction from these headers.

Clean-fuel piping is copper tubing.

PRINCIPAL POWER-PLANT EQUIPMENT

Tacubaya Diesel Plant, Mexico City, D. F., Mexican Light & Power Co., Ltd

GENERATING EQUIPMENT

Engines, 6 12-cyl 29x40-in. 167-rpm crosshead, port-scavenging 2-cycle solid-injection diesels; 8650 hp at sea level; 7350 hp at 7500 ft	Nordberg Mfg Co
Forgings: crankshaft, camshaft, connecting rods	Erie Forge Co
Fuel-injection systems	American Bosch Corp
Bearing shells: main and crankpin	American Bearing Corp
Piston rings (American Hammered)	Piston Ring Div, Koppers Co
Cylinder lubricators	Manzel, Inc
Barring-gear motors	Master Electric Co
Barring-gear-motor controls	Cutler-Hammer, Inc
Governors, hydraulic	Woodward Governor Co
Starting-air compressors, two, 250-psi	Ingersoll-Rand Co
Generators and exciters, switchgear	General Electric Co
Batteries	Gould Storage Battery Corp
Pressure gages	J E Lonergan Co
Thermometers	Taylor Instrument Co's
Alarm systems	Viking Instrument Co

INTAKE AND EXHAUST SYSTEMS

Intake silencers	Burgess-Manning Co
Air filters, automatic	American Air Filter Co Inc
Scavenging blowers, centrifugal, motor-driven	Elliott Co
Scavenging-blower motor controls	General Electric Co
Exhaust mufflers, with heating coils	Burgess-Manning Co
Exhaust pyrometers	Illinois Testing Laboratories, Inc
Flexible exhaust connections (Also flexible hose for oil, water, air, etc)	Zallea Bros & Johnson

LUBRICATING-OIL SYSTEM

Lube-oil pumps (IMO)	DeLaval Steam Turbine Co
Lube-oil transfer pumps	Blackmer Pump Co
Lube-oil transport pumps	DeLaval Steam Turbine Co
Lube-oil coolers	Condenser Service & Engrg Co, Inc
Lube-oil strainers, at engine	Elliott Co
Lube-oil strainers, unloading	Blackmer Pump Co
Lube-oil filters, at engine	U. S. Hoffman Machy Corp
Lube-oil centrifuges	Sharples Corp
Lube-oil and cylinder-oil meters	Buffalo Meter Co
Lube-oil-storage-tank controls	Mercoid Corp
Storage-tank low-level alarm switches	Mercoid Corp
Lube-oil pressure gages	J E Lonergan Co

WATER-SUPPLY AND COOLING SYSTEM

Cooling tower, 3 sections, 6 fans	J F Pritchard & Co
Jacket-water heat exchangers	Condenser Service & Engrg Co, Inc
Jacket- and raw-water pumps	Ingersoll-Rand Co
Water softener, zeolite, 11 gpm	Permutit Co
Water meter	Buffalo Meter Co
Temperature-regulating valves	Fulton Sylphon Co
Deepwell pumps, two, 750 gpm each	Worthington, Layne & Bowler
Service-water pumps, three, 150 gpm each	Worthington Pump & Machy Corp

FUEL-OIL HANDLING AND HEATING SYSTEM

Fuel-oil filters, at engine	Wm W Nugent & Co
Fuel-oil filters, before centrifuges	Cuno Engrg Corp
Fuel transfer pumps	Hiram H Haight, DeLaval Steam Turbine Co
Fuel-unloading pumps	DeLaval Steam Turbine Co
Fuel-oil centrifuges, 1000 gph	DeLaval Separator Co
Fuel-oil strainers	Elliott Co, Blackmer Pump Co
Fuel-oil heaters	Ross Heater & Mfg Co, Inc
Fuel-oil meters	Buffalo Meter Co
Boiler-feed and hot-water pumps	Ingersoll-Rand Co
Hot-water heat exchanger	Ross Heater & Mfg Co, Inc
Temperature-regulating valves	Fulton Sylphon Co
Steam-drum level control and alarms	Mercoid Corp

MISCELLANEOUS EQUIPMENT

Overhead cranes, electric	Harnischfeger Corp
Motors for various auxiliary drives	Louis Allis Co, Westinghouse
Fire-pumps, high pressure	Worthington Pump & Machy Corp
Insulation, rockwool	Materiales Aislantes (Monterrey)
Copper-tube fittings	Chase Brass & Copper Co
Valves, 3-way	Crane Co
Valves, gate, globe, check, etc	Crane, Lunkenheimer, Lonergan

with sweated copper fittings, tin-antimony soldered. All hot fuel pipes are insulated with rockwool blankets, formed at the site and finished with a coat of hard-setting cement. Disk-type fuel meters in flow and return pipes to each engine provide for routine efficiency checking.

Changeover from heavy to light fuel, or vice versa, necessary when starting and stopping a unit, is done by coupled 3-way valves, conveniently located near each engine.

Fuel Heating. An elaborate hot-water fuel-heating system uses exhaust heat. Each of the 12 exhaust mufflers has a 150-sq-ft heating coil. Through these coils, all connected in parallel, 400 gpm of water circulates. Two secondary heating circuits, each with a pump, convey hot water to coils in unloading ports, heaters in each of the main fuel-storage tanks, heaters ahead of the centrifuges, and to the final heaters just ahead of the engines. Treated-water storage and duplicate feed pumps supply makeup needed. A heat exchanger, using cooling-tower runoff water controls temperature of the hot water. A thermostatic bypass valve makes this control automatic.

As shown in diagram on p 76, the hot-water system is closed and operates at 240 F. The steam drum is fitted with high- and low-level alarms and automatic level control. All pumps are installed in duplicate.

Electrical System. The 6.3-kv bus, to which all generators feed, is included in the metalclad switchgear in the control room. Tie switches connect bus sections; a feeder from each section goes to the substation. Differential protection and automatic voltage control are provided for the generators. Delta-wound scavenging-blower motors are protected by thermal relays sounding an alarm in case of operating overloads, and by induction overcurrent relays causing generator main and field switches to open in case of heavy sustained overcurrent.

Two 2000-kva 6300/440-v transformers, one connected to each bus section, supply auxiliary power. The 440-v auxiliary control board, containing 30 feeders to various plant auxiliaries, is also located in the control room.

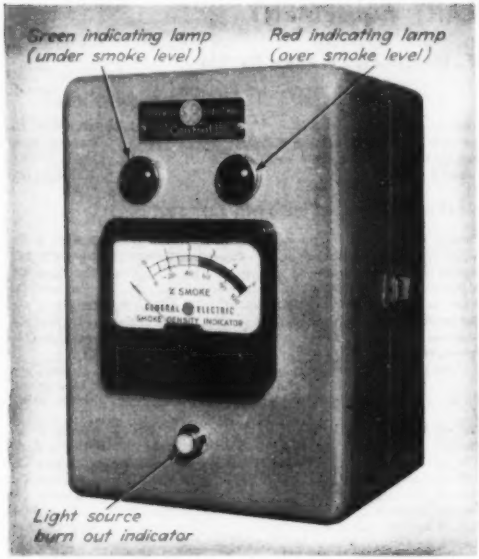
The diesel plant depends on outside power for starting, but in heavy and prolonged system disturbance, outgoing feeders from the plant will trip, leaving the diesel plant isolated but supplying its own auxiliaries.

Performance. At plant elevation, and with fuel oil of 19,350 Btu per lb (higher heating value), guaranteed fuel-consumption rates are:

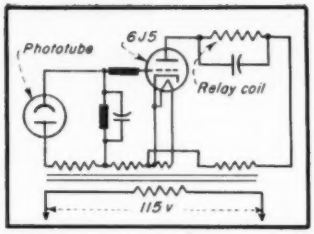
Percent load	100	75	50
Gen efficiency at 0.8 pf	94.0	93.6	92.2
Fuel rate, lb per net kwhr	0.585	0.605	0.670
Heat rate, Btu per net kwhr	11,300	11,700	12,950

These figures take into account energy delivered to the 6.3-kv bus, power to the scavenging blower being considered as an engine loss.

Up to the time of preparation of this article, official tests had not been carried out but indications are that guarantees will be met with some margin to spare.



1 Plant operator can keep close tab on smoke density when smoke indicator is installed on the boiler control panel



2 Light on phototube determines grid voltage that controls plate current

Nucleus of many smoke-density control and indication systems now in use is either a phototube or thermocouple. The same general principles are used for liquids in measuring and controlling the specific gravity and turbidity

By D ELDRED, *Control Div, General Electric Co*

Smoke-Density Indication and Control

► EARLY FORMS of excessive-smoke indicators used visual means alone as a way of noting excessive smoke. First electronic circuits after development of phototube were used as simple relays. That is, a change in light intensity caused a magnetic relay to operate, which in turn controlled some auxiliary device. These relays were mighty successful when used for counting, limiting, sorting and similar applications. In addition, they were used to indicate presence of excessive smoke. As a smoke-density control, however, they lacked many desirable features for successful operation.

Many factors have to be considered when using phototubes as smoke-density indicators. Basically, the electronic circuit and light source must be stable with respect to temperature, line-voltage variation, excessive-dust conditions, changes in light levels, and other conditions that may cause inaccurate operation. A good design considers all these factors at the lowest possible cost.

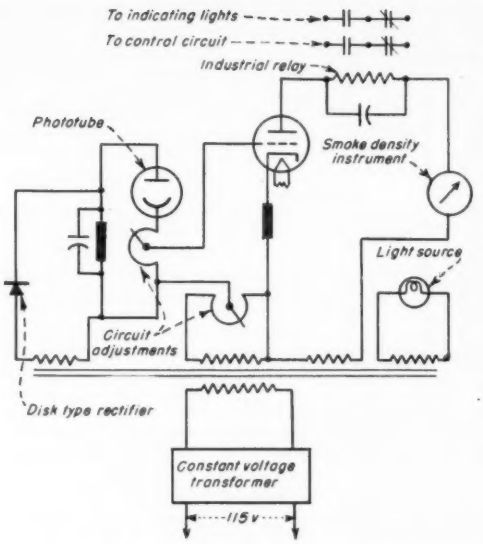
Fundamental Circuits. Basic photoelectric-relay circuit in Fig. 2 operates as follows. Voltage applied to phototube produces a current proportional to the amount of light falling on phototube cathode. This current develops a voltage across resistor in series with phototube, converting proportionally the current signal to a voltage signal. This signal is then fed to the grid of a simple radio-type vacuum tube controlling the tube's plate current. A magnetic relay is in series with the plate of the tube and operates when the current reaches a predetermined value. This circuit may be used for smoke-density control.

Developed circuit in Fig. 3 has incorporated many features necessary for satisfactory operation. Fundamentally, this second circuit works the same as the first. Following are some added features: (1) a regulating transformer to compensate for line-voltage changes (2) a resistor to amplifier cathode to improve circuit linearity (3) an industrial-type relay having a higher contact rating. This eliminates need for a second relay when certain control features are desired.

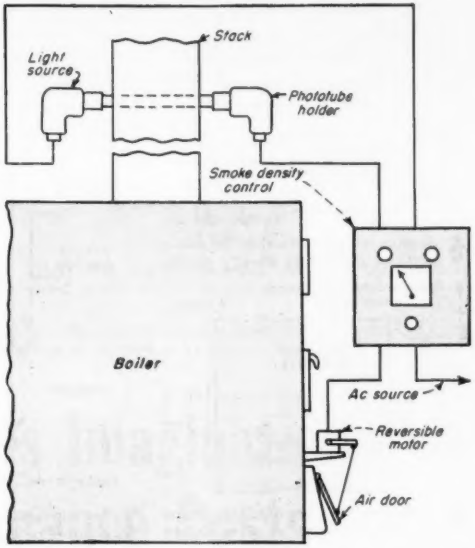
An indicating meter is added in series with the amplifier tube. This meter is calibrated in Ringelmann units and percent smoke density. An adjusting control facilitates installation and helps compensate for initial conditions. Dust-tight construction is used on both control panel, phototube holder and light source, to increase life of control and insure trouble-free operation. Indicating lights and meters are included as part of the basic design. The unit now has the features necessary for complete smoke-density control.

Installation Data. Following items should be considered when using photoelectric smoke-density controls. Control should become part of a control center. It may be best to have the control turn on blowers or overfire jets when excessive smoke is present. Overfire jets may be used to keep smoke formation to a minimum by forcing air into the furnace when needed. Smoke-density control can be adjusted to operate the jets at any smoke-density level desired. Then again, the smoke-density control can be used to sound an alarm or perform some other control functions.

Perhaps the most important consideration is installation of phototube holder and light source. It is necessary that both light source and phototube holder be placed a slight distance from duct work or stack opening so a natural draft helps keep lens clean. Phototube holder is designed so extraneous light is kept to a minimum.



3 Circuit in Fig. 2 developed to include smoke-density meter, regulating transformer, industrial relay and potentiometers



4 In addition to control of air door on boiler front, unit can turn on overfire jets when excessive smoke is present

with Either Phototube or Thermopile

There has been some correlation between smoke density, percent CO_2, and percent of excess air necessary for most efficient operation. When smoke density is about 15 to 20% (a light haze) you are operating at maximum efficiency. With a *2-point* smoke-density unit it is possible to control combustion to get maximum operating efficiency. Fig. 4 shows a simple door damper control to regulate the fire's air supply. In this unit, as smoke density increases or decreases, magnetic relays operate the motor to increase or decrease air supply.

Operating Results. Perhaps the greatest errors in smoke-density indication are the result of line-voltage changes. Transient effects may be limited by good circuit design—for instance, by making the circuit unresponsive to transients. A constant voltage transformer adds much to accuracy in operation. With this and good circuit design, smoke density can be indicated to within plus or minus 3%. This accuracy can be maintained over relatively long periods. Nevertheless, like any other control device, proper maintenance is necessary to insure continued reliability and accurate operation. Remember that for accurate operating results lenses should be cleaned periodically and the calibration checked.

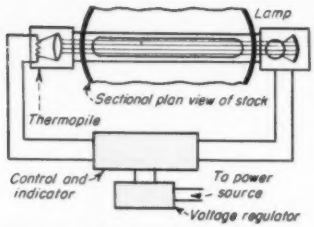
Auxiliary Controls. As with any other installation, many auxiliaries can be added for improved operation. Perhaps the auxiliary most frequently added with smoke-density control is a recorder. This permits taking a continuous record of smoke conditions, and is a form of protection against ordinance violations. This record may also be used as a general indication of plant efficiency.

Recorders fall into two classes: (1) for a continuous record of smoke density and (2) for a record only when a certain predetermined smoke level is exceeded. The former is necessary where an accurate continuous record of smoke density is required. This type connects in series with the electronic circuit and reads the same as the panel-indicating meter.

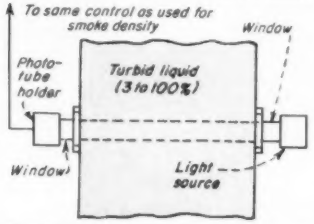
The second type uses a standard voltmeter recorder connected through the panel relay contacts. When the relay operates at some predetermined smoke level, say 20%, the voltmeter records at some preset point. Remote indicating meters may be best where the panel installation is not permitted. A large standard meter connects in series with the electronic circuit for remote indication. Different combinations of the above auxiliaries may be used depending on individual conditions.

Another Method. Smoke density can be indicated by a thermopile arranged with a light source as the temperature-radiating body. Fig. 5 shows a hookup whereby smoke density is measured by the radiant-temperature method. In this case a projection spot-type lamp is arranged so light falls upon a thermopile. Amount of heat transmitted from lamp to thermopile depends on how much heat is absorbed by smoke particles. Thus with a large number of particles more heat is absorbed, indicating a greater smoke density.

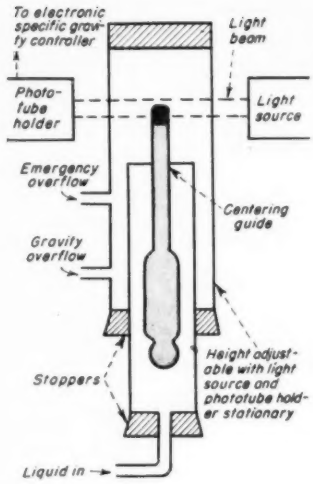
Signal to thermopile connects to an amplifier, which in turn operates an indicator calibrated in smoke-density terms. To maintain accuracy it is necessary to compensate for ambient temperature changes at the thermopile. Again, surfaces of radiating body and receiver must be kept free of dust and soot. This is handled in the same way as with the photoelectric control. For greater accuracy it is best to operate



5 Amount of heat absorbed by smoke particles determines density reading



6 Phototube used for turbidity control of discharge water in sewage plant



7 Specific gravity varies float height controlling light received by tube

lamp and amplifiers from a voltage-regulated source.

Generally speaking, this system is more expensive than photoelectric control since greater amplification and temperature-compensating circuits are necessary. This type of equipment can perform the same control operations as the photoelectric system.

Specific Gravity and Turbidity. The phototube smoke-density equipment can be used to indicate specific gravity or turbidity by a proper arrangement of sampling equipment. Fig. 7 shows one method of measuring specific gravity. With this arrangement the liquid is pumped into bottom of glass tubing in which a specific-gravity gage floats. Upper end of gage is opaque and positioned to control light on phototube.

Light source and phototube holder are located so light beam can be intercepted by top of bulb. If vertical movement of the bulb is linear with specific gravity, then a rectangular-shape light beam is used. As the bulb moves up and down, light on the phototube is a measure of specific gravity. This in turn shows on a meter calibrated in terms of specific gravity. This same equipment may be used to control specific gravity. Thus, when the meter reaches a predetermined level, a relay operates to control some part of the process that regulates specific gravity.

Beam shape can be changed to compensate for nonlinear movement of bulb with respect to specific gravity. For instance, the beam may be wedge-shaped, giving a greater signal as bulb intercepts a lower part of beam. Correspondingly, a small signal will result as the top of beam is blocked. Light beam is shaped by a suitable aperture to insure a linear scale reading for specific gravity.

Again, this same control can be used to indicate liquid turbidity. Fig. 6, where 3 to 100% light transmission is proportional to turbidity. For a sewage plant, a sample of the discharge water is fed through a glass tube and the light source and phototube holder arranged to indicate turbidity of liquid. In each case light transmission through the liquid is assumed to be a measure of turbidity. Here again the panel relay is set to operate at any turbidity level to control some part of the process as a function of turbidity.

These are typical examples of how photoelectric and thermopile control is used to show density of various gases or fluids. This same control may be used to indicate density of any medium where the light transmission is a measure of the density if adequate light is transmitted to operate the device. It is simply a matter of arranging the various electronic components so the proper signal is obtained.

The whole picture of smoke indication and control is coming more to the front each day as community groups and industrial public relations boards are joining hands in solving smoke abatement. This problem is a possible health hazard in addition to being a nuisance.

Some combinations of weather, smoke and fog may produce a hazardous atmospheric condition. This was vividly brought out in the Belgium catastrophe of 1930—a rarity indeed but, nevertheless, a potential source of trouble.

Tips on Fluorescent Lamp Disposal

► YOU'VE PROBABLY READ in the daily newspapers about the possible danger in breaking fluorescent lamps. The danger creeps into the picture when beryllium dust—that's the stuff on the inside of fluorescent lamps—gets into the lungs, an open wound or a cut. And that's liable to happen if you try busting old fluorescent lamps without using certain precautions.

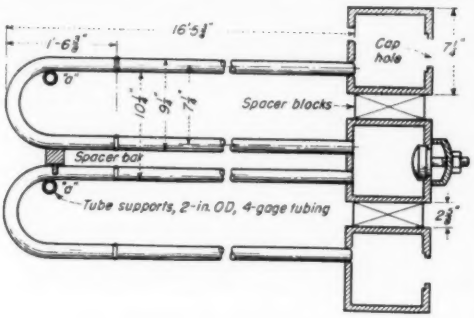
Here's How. It's difficult to say which is the one best method of lamp disposal. Much depends on the number of lamps to be disposed of, the type industry, general facilities, location, etc. There are four fundamental steps that should be kept in mind. Any method that incorporates all four will keep you out of trouble.

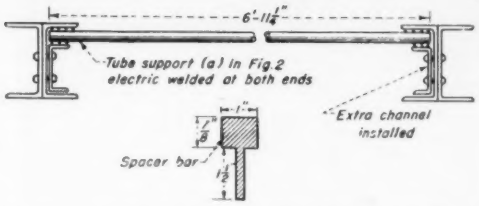
The four rules are: (1) Use goggles to protect eyes. (2) Use gloves to protect hands. (3) Protect against infection by thoroughly cleansing all wounds that may have come in contact with beryllium dust. (4) Avoid inhaling beryllium dust.

One practical method is to take the old lamps to the dump and crush them under the wheels of the dump truck. Then cover them with other debris. This ends the possibility of children finding the tubes and using them as playthings.

Fluorescent lamp manufacturers plan to stop using beryllium in the manufacture of lamps after June 30th. But remember that won't change the picture for those lamps now in use.

REDESIGN OF TROUBLE-MAKING ECONOMIZER USES OLD MATERIAL TO BUILD NEW





1 *Above:* Changing straight-tube economizer to U-tube design meant special 10-in. standard channels for tube supports

2 *Left:* Redesign produced a leak-tight economizer with all tubes as separate units seal welded in header at one end

Arc Welding Plus Imagination Halves Maintenance Costs

Today's boiler room expects long, uninterrupted service from steam generators. Here's how arc welding converted a failing old economizer into a modern unit at half replacement cost

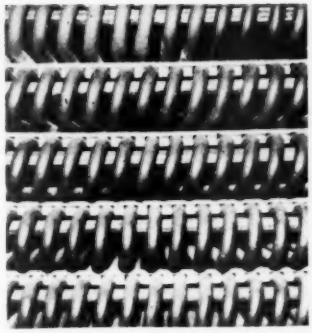
By J B COTTER, *Supt, Central Illinois Public Service Co**

► WHEN A STEAM GENERATOR goes on the line in a modern central steam plant it runs upwards of six months to a year before shutdown. This operation enables setting up a scheduled maintenance program for expected out-of-service units. Any unexpected outages mean unscheduled maintenance.

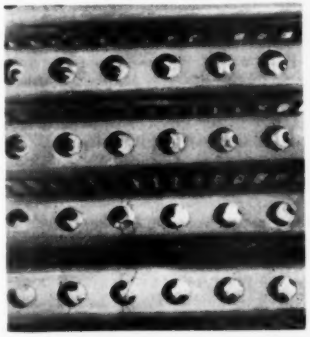
At the Grand Tower Power Station of the Central Illinois Public Service Co. —a 50,000-kw station—a frequently recurring boiler outage created a maintenance and operating problem. That outage occurred in a steam-generating unit equipped with a wrought-steel 2-in. watertube economizer—7080 sq ft of heating surface. Economizer design was an outmoded one with straight tubes expanded at each end in a forged-steel square-box-type header—at one time a widely accepted design.

No matter how tightly tubes were rolled into these headers they invariably slipped. Possibly occasional rapid changes in the temperature of the flue gas passing over these tubes helped the slipping along. But once they slipped, water leaked out. Since the water was under pressure and the points of leaking were small, there developed a rapid erosion of tube ends and cap holes in the tube headers. Over and above the maintenance problems from this source were those contributed by defective handhole gaskets. It all added up to a need for a permanent remedy.

After lengthy study and consideration the only cure seemed a complete redesign of the economizer. The redesign resulted in a U-tube construction with headers at one end, Fig. 1, 2, 4. Such a redesign meant all tubes became separate units with tube ends seal-welded in tube holes in each of the headers, Fig. 4. This design takes care of any and all expansion and contraction caused by flue gas or feedwater-temperature differentials. It eliminates all danger of tube slip and its attendant water leakage. But how to effect this redesign?

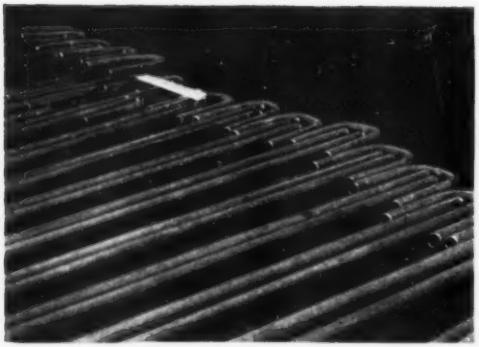


3 Welded U-tube ends show spacers between tubes and supports below rows

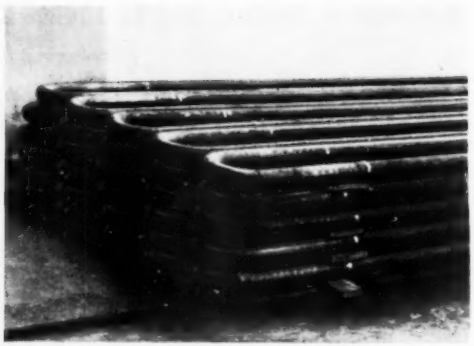


4 Opposite ends of tubes seal-welded in place in the header-tube holes

*Welding data and illustrations are from a study submitted to the James F Lincoln Arc Welding Foundation in its recent $200,000 Design-for-Progress Award Program, for reports, advances and improvements made by the application of arc welding in design, fabrication, construction and maintenance

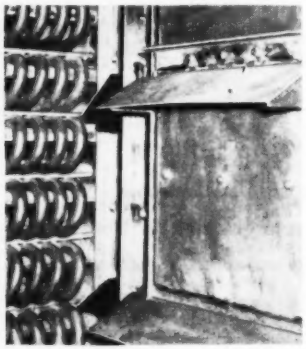


5 Sets of two tube lengths were brought up, matched and marked for cutting off to size and welded to the U-tubes



6 Finished U-bend tube units show where welds were made on tubes. Tube assemblies replaced the old straight tubes

7 Special jig setup for welding tube lengths and U-bends had each end resting on rollers so operators could turn the material without breaking the welding arc



8 Steel-deflector doors electric-welded to economizer, inside, bypass hot gas

Converting Design. Conversion of the existing economizer to a U-bend design meant (1) removing all tubes and headers at both ends (2) building up the eroded cap holes in 22 of these headers—just enough headers for the water inlet end (3) making U-bend tubes out of the old tubes.

Here is how we went about the conversion. Electric arc welding provided the answer for the job of building up the 22 eroded tube-header cap holes. Each header took 7.2 lb of No. 5 Fleetweld $\frac{1}{8}$-in.-size electrodes. After welding and grinding out the cap holes a refacing machine faced out the handplate seat. Next tube holes in each header were faced off on the inside to prepare them for later seal-welding of U-bend tube ends.

Some of the salvaged tubes, cut into short pieces about 3 ft long, made up the stock for U-bends. A bevel at each tube end fitted it for good welding into the tube lengths. The bending was achieved by (1) filling and tamping with sand (2) heating to a cherry red in a simple open charcoal furnace (3) bending to proper gage in a small pipe bender.

Finished U-bends were placed in one end of a homemade jig. Then two tube lengths were brought up, matched and marked for cutting off to give proper length when assembly was completed. After cutting to length, matched tubes and U-bends were set aside for welding. Fig. 7.

These matched sets of two tube lengths and a U-bend made up a single unit. Fig. 5, and were placed in a jig to be electric welded. This jig for the welding phase was an on-the-spot design. Each end rested on rollers so the operator could turn the material without breaking the welding arc. Fig. 6 pictures a number of the fabricated U-bends.

Each U-bend tube end underwent annealing. It was then beveled to 37 deg so it could receive a good electric seal-weld when in place in the header-tube holes.

With one set of 22 reconditioned tube headers (for front end only) and 420 U-bend tube units, the economizer rebuilding program could be started.

First we put tube headers in place and installed U-bend tubes, one header at a time. With all tube headers eliminated on the rear end a special support had to be made. Tube support *a*, electric welded to the permanent structural-steel channels, Fig. 1, proved satisfactory.

In addition, a spacer bar Fig. 1, installed between each of the 21 rows of U-bend tubes provided proper spacing, both vertically and horizontally at the rear end of the economizer. Space bars were fabricated by electric welding $\frac{1}{4}$x1$\frac{3}{8}$x1$\frac{1}{2}$-in. plate steel spacers onto a $\frac{7}{8}$x1-in. steel bar of the required length. These bars were then bolted at each end to a steel lug, electric-

welded to the permanent structural steel channels.

With all headers and tubes in place, Fig. 2, the end of every tube was (1) expanded into the header-tube hole (2) electric seal-welded—through the header cap holes—Fig. 4 and (3) re-rolled to place tube wall solid against header-tube hole wall following the heating picked up from the electric seal welding, (2).

The space between the U-bend end of the tubes and the economizer door could serve as a bypass for hot flue gas. To prevent this, steel deflector doors were electric-welded to the inside of the economizer doors, Fig. 8. They were spaced between every third bank of tube bends. When doors closed, deflectors made a snug fit with the tube spacer bars.

Operating Experience. Since the redesign, enough operating experience has been compiled to claim:

1. Elimination of tube leakage from tube-end deterioration
2. Reduction in maintenance costs for labor and material formerly spent replacing leaking tubes
3. Reduced boiler outage
4. Improved boiler operating efficiency from eliminating unscheduled boiler outage
5. Cleaner economizer passes
6. Longer operating life.

COMPARATIVE COST ANALYSIS

DATA:

Direct-maintenance cost (material and labor) of this economizer for the 12 months just prior to the redesign (Oct. 1, 1945 to Sept. 30, 1946) $1480

Direct maintenance cost of this economizer since redesign, Nov. 1, 1946 to present date (May 1, 1947), a six months' period 0

Total cost of redesign job 6515

Time required to pay total cost of redesign, based on elimination of prior annual maintenance costs ..... 4.4 years

REDESIGN VS. REPLACEMENT COSTS

Items	Cost by using new materials, installed according to original design — headers at both ends of economizer	Salvaged material rebuilt by building-up and making-up by welding to new design — U-bend tubes and headers at one end only	Cost difference	Saving percent
Tube headers front end	22 at $184 each... = $4048	22 at $52 each..... = $1144	$2904	71%
Complete set 2-in. tubes	840 size 2-in. OD x 16-ft long tubes at $4.21 each..... = 3536	420 U-bend tube units at $2.55 each = 1071	$2465	69%
Tube headers rear end	21 at $184 each.....$3864	None — eliminated by U-bend tubes 0	$3864	100%
All labor: (includes $200 for incidentals)	$4300	$4300	0	0
Totals	$15,748	$6515	$9233	58%

Can Your Welding Hookup Meet the Code?

Abstracted from paper, "Arc Welding—Safely Speaking," by W W Reddie, Westinghouse Elec Corp, before National Safety Congress, Chicago, Oct 21, 1948.

In the usual industrial operation, driven by electric power, primary wiring gets most attention. The welding circuit makes up the machine's output side. So both wirings—primary and secondary—deserve equal attention.

Proper Connections. For the first time, the 1947 National Electrical Code covers proper installation procedure for both dc motor-driven and transformer-type ac welders. The Code gives standard practice for circuit protection and primary conductor size.

Note that the service is recognized as a duty cycle rather than continuous. This recognition provides a saving in copper on primary circuit conductors. The long-standing practice of magnetic starters rated in amperes instead of horsepower is part of the Code.

Purely from a safety standpoint the Code now calls for a number of extra provisions. For instance, a breaker in the primary of ac welders is a must. It can be a switch, rated in horsepower, or a circuit breaker, but it must be there. Where motor starter, switch or circuit breaker is mounted on or at the welder, its presence should never be considered as protection for the primary power-supply circuit. That protection must be provided.

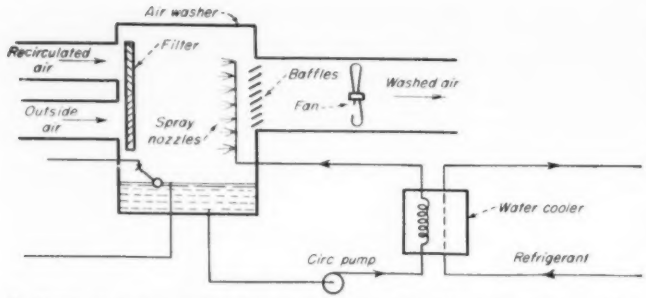
Further, any device mounted on an ac welder should be capable of opening the circuit under any load conditions. Code covers proper selection of breakers or switches for this duty.

Ac or dc machines must always be firmly grounded from frame or welder case. In permanently installed machines this requirement is easy. In portable units, it can easily be overlooked.

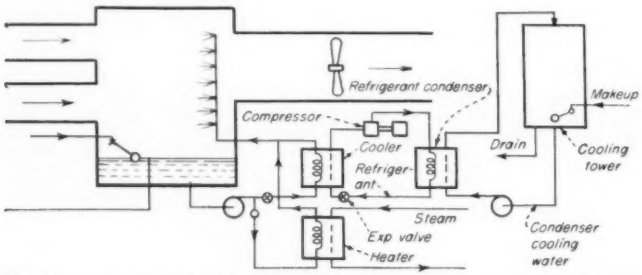
Multi-conductor primary cables are recommended. Small, portable single-phase ac welders usually come with underwriter-approved primary cable of 2-power conductors and ground-wire, together with primary fittings.

Balancing Circuits. When a number of welding machines are put on a circuit the problem of balancing load comes up. At this time the questions of polarity and phase relations of welders should also be reviewed. *The American War Standard on Safety in Electric and Gas Welding and Cutting Operations* gives explicit instructions on how to handle this problem.

As an example of what could happen consider two dc generators. One is set up for straight polarity work—holder negative—the other for reverse polarity—holder positive. Open circuit voltages—maximum allowed, 80 v—are additive. Suppose the work terminals of these two welders are grounded, which is usual. A person, coming in contact with uninsulated parts of the electrode terminals, cables or holders, would complete the circuit across 160 v.



1 Simple air washer cools and lowers humidity of incoming air—a primary objective of air-conditioning—but the cooling water becomes highly corrosive



2 When you take the absorbed heat out of the spray water with a refrigerant you add a condenser cooling-water circuit that needs protection against corrosion

Preventing Corrosion in Air-Conditioning System

By **W J RYAN**, *Technical Manager, Water Service Laboratories, Inc*

Corrosion is one operating difficulty that need not be tolerated. All you need know is required chemical makeup of your circulating solution —water or brine. Make it non-corrosive, hold concentration

► OPERATING air-conditioning and refrigerating systems is easier when corrosion is kept under control. Beyond the direct damage it does from contact of water and brine with the equipment —pipelines, pumps, spray chambers, cooling towers, condensers, etc—there is the effect the corrosion products have on performance. Rust and bits of corroded metal clog up spray nozzles and heat-exchanger passes.

The problem is aggravated by electrolytic or galvanic action at points of contact between the different metals used in construction of the equipment. Let's look at the factors involved and the steps to control corrosion.

Raw Water. Most natural waters are corrosive to metals, especially the softer waters and those containing only small amounts of alkaline salts in solution. Artesian-well waters tend to be particularly corrosive because they carry such large quantities of dissolved carbon dioxide (CO_2). This natural corrosiveness of water increases in cooling towers, air washers and evaporative condensers because water absorbs air and impurities in it—carbon dioxide, sulphur dioxide from smokestacks, etc.

Most effective treatment for water in air-conditioning systems involves (1) raising pH with an alkali (2) forming a passivating film on metal surfaces by adding sodium chromate. Complete corrosion protection results from keeping the proper concentration of chromate in the water, plus a pH of about 8.5 at all times. To do this means frequent water analyses and regularly adjusted feeding of chemicals.

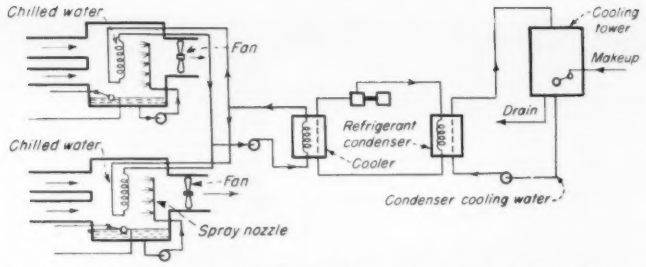
Control of pH has a direct bearing on rate of corrosion. Without going into the derivation of the term pH it can be stated that, within limits, the higher the pH, the less corrosive the water, and vice versa. Most city waters have a pH of about 7.0 unless the city applies some special treatment to its water. If it adds some material like lime or sodium silicate, the pH will probably be 8.0 or a little higher. In steam boilers where alkaline chemicals are added to prevent scale and corrosion, boiler-water pH is usually between 10.5 and 11.5, or higher.

Let's see what happens to the water in air-conditioning equipment. Air washers, Fig. 1, pass air through a chamber where water circulates as a spray. The water has undergone cooling in a refrigerating system. The cold-water spray washes dust and impurities out of the air and condenses some of the entrained moisture. This cooling and lowering of the humidity in the air is one of the primary objectives in comfort air conditioning.

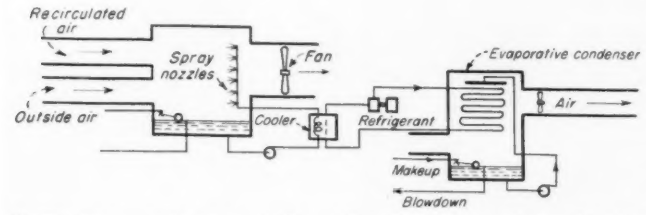
But this spray water continually absorbs carbon dioxide from the air so the pH falls and the water tends to become very corrosive. Unless chemical treatment is used to hold up the pH, corrosion can proceed apace. To a lesser degree, water passing through evaporative condensers or cooling towers experiences the same change in pH.

Corrective Measures. To prevent inside surface corrosion of air washers and water-circulation systems, a combination of chemicals—alkali and sodium chromate—should be fed into the spray water. Actually, sodium dichromate acts as supply for the chromate; it combines with the alkali to form sodium chromate.

In some plants these chemicals are fed intermittently in daily doses. Best practice employs a chemical feeder that



3 The chilled-water arrangement for removing heat from spray water is often a closed circuit where air is not absorbed and, hence, corrosion is no problem



4 Circulating water in an evaporative condenser becomes corrosive by absorption of CO_2 and other acidic compounds from the air. Protection must be provided

operates whenever the spray water's circulation pump does. This maintains the water in the most favorable condition at all times.

Fig. 2 shows a further development of the simplified air washer in Fig. 1. Incoming air can be either cooled or heated. Cooling is effected by spray water, which goes through the cooler in the refrigerating system.

This system consists of a compressor for the refrigerating gas (ammonia, carbon dioxide or some other refrigerant) and a condenser for liquefying the gas. From here the liquefied gas passes through expansion valve to the cooler, where it expands to absorb heat from the spray water.

This process introduces another circulating-water system—the one that carries water for condensing the refrigerant. In very small plants this water may be drawn from the city supply and pass through the condenser and out to the sewer. Some cities have ordinances forbidding this use of water because it is so wasteful.

One way to conserve the refrigerant condenser water is to recirculate it through a cooling tower, Fig. 2. In the tower the water, flowing down over baffles and fill, comes in contact with an air stream and is thereby cooled. This contact with air lowers pH, and produces a corrosive water. Without countermeasures, corrosion damage in cooling tower, piping and refrigerant condensers may well become a problem.

A somewhat different air-washer arrangement, Fig. 3, employs a chilled-water circuit. Spray water is not directly cooled by the refrigerating system but, instead, sprays over coils carrying the chilled water in a closed circuit. Here the spray water needs chemical treatment because of its contact with air. But the closed circuit probably does not need this protection.

What about an evaporative condenser? Fig. 4 shows a system where the refrigerant is condensed in an evaporative condenser. A circulating pump keeps water moving through spray nozzles that play the water over the refrigerant coils. An air blast, forced through the chamber housing coils and sprays, cools the circulating water. In this arrangement chemical treatment is added to the two waters that come in contact with air: (1) the air washer's spray water (2) the circulating water in the evaporative condenser.

Brine Treatment. In refrigerating systems employing brine, sodium chromate provides an effective and economical defense against corrosion. It requires a chromate concentration of about 2000 ppm for calcium brine and 3200 ppm for sodium brine. Since chromate has an acidifying action, caustic soda may also be used to raise and hold pH of the treated brine at 7.5 to 8.5. At the same time, the caustic combats lowering of the pH caused by any absorption of CO_2. Periodic analyses and regularly adjusted chemical feeding are the only sure ways to prevent corrosion.

Ammonia escaping through a leak into the brine makes it too alkaline. If alkalinity tests indicate that this is happening the leak should be located and repaired as quickly as possible.

In handling chromates and caustic soda considerable care must be exercised. These chemicals can irritate or burn the skin or injure face and eyes.

Scale Prevention. Suppose in addition to being corrosive, the water is hard, that is, contains large amounts of calcium and magnesium salts. Because of the evaporation that takes place in cooling towers, air washers and evaporative condensers, these mineral salts tend to concentrate in the same way as in a boiler. Eventually they come out of solution and form scale.

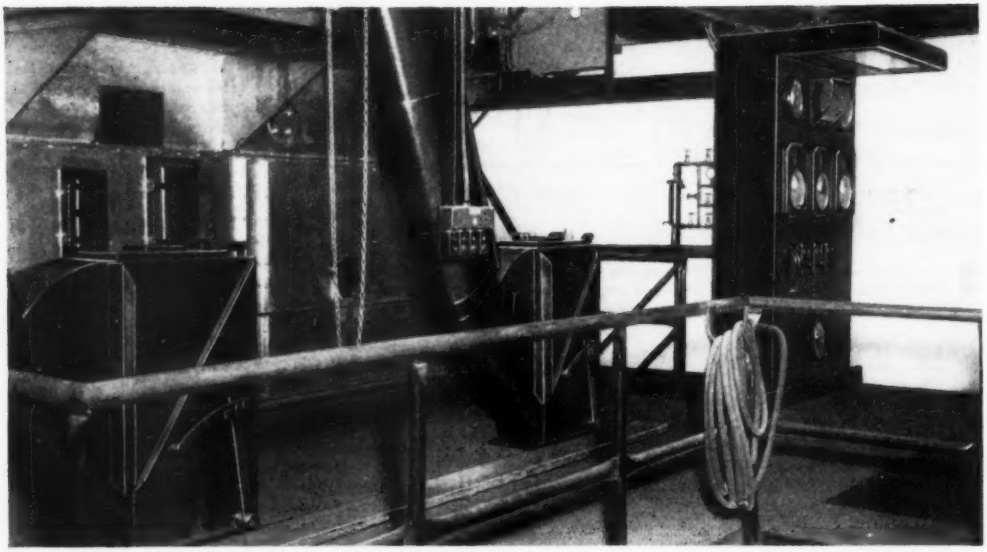
Over and above this scale is the coating that may form on heat-transfer surfaces from the dust particles, bacteria and pollen absorbed by water. Such organic growths give water an offensive odor, which in turn is imparted to the air. Proper chemical treatment can reduce such difficulties.

Just what does chemical treatment for scale prevention involve? There are several acceptable approaches. A zeolite softener on the makeup-water supply can prevent or minimize scale troubles by softening the water. Surface-active materials, such as certain polyphosphates, may achieve the same result. Bleeding a small stream of water from the circulating system tends to keep the concentration of dissolved mineral salts below the point where they precipitate as scale.

Bleeding or blowdown, with other water losses, affect the amount of chromate and alkali needed for the anti-corrosion treatment. As an example, moisture condensed from air passing through the air washer, Fig. 1, drops into the well at the bottom of the chamber and causes a continuous small overflow. This overflow carries away some of the chemicals, and pH of the water drops unless a continuous automatic chemical feeder is provided.

In cooling towers some circulating water is carried off by drift or windage. In mechanical draft towers rate of such loss runs to about 0.2% of circulation rate. For natural draft this loss ranges to about 2% depending on wind velocity. Spray ponds have an even higher loss from this cause.

But no matter what the particular air-conditioning equipment used, in handling the water or brine an active, closely followed chemical-treatment program can extend service life by reducing or preventing troubles from corrosion or scale formation.



1 New boiler has 45,000-lb-per-hr maximum steam capacity at 600 psi and 725 F, total temperature. Unit is fired by hog fuel in a dutch-oven furnace equipped with watercooled grates. They operate with combustion air at a temperature of 500 F

Low-Cost Power Is Produced by

High-pressure boiler, hog-fuel fired, supplies steam to motor-generators that act as reducing valves between high-pressure and process-steam lines. Units generate paper-machine power

► Westminster Paper Co. Ltd. manufactures a wide range of paper and paper specialties at New Westminster, B.C., Canada. For many years, the company has modernized its plant to maintain high operating efficiency and reduce costs. During the war, maximum production was obtained with existing equipment, so by the end of 1945 an extensive modernization and expansion program had to be undertaken.

W O Stevens was employed as consulting engineer to (1) study steam requirements for expanding paper-making capacity (2) determine size and pressure of needed steam equipment for this expansion (3) investigate possibilities of generating byproduct electric power (4) evaluate advantages and disadvantages of available fuels. The company's engineering staff, headed by J Ashby, mill manager, directed this work.

Old Boilers. Back in 1945, all power was purchased, whereas steam for the one paper machine was generated by two 1650-sq-ft 150-psi hrt boilers. These units did not have enough capacity for a second paper machine. Therefore, rather than install a third low-pressure unit, the decision was in favor of a high-pressure one with capacity to supply all steam requirements for two new paper machines, and eventually a third.

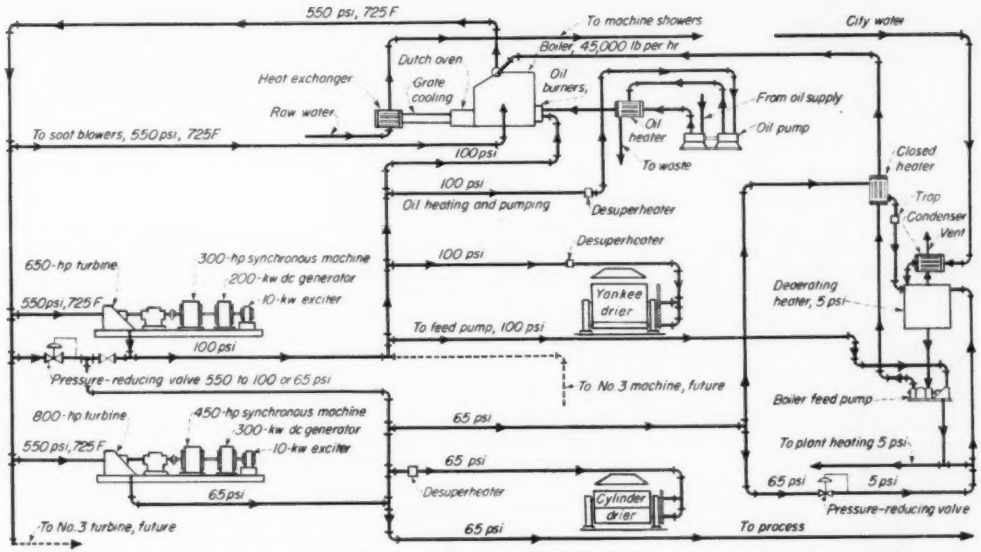
From the old 150-lb boilers, steam passed through pressure-reducing valves to supply the paper-machine driers, process and the heating load. Condensate from these sources returned to an open hotwell in the boiler room where it mixed with the necessary makeup, and was returned to the boilers by reciprocating pumps.

Expansion Program. As a first step, the mill building was extended to house a second paper machine and provide more manufacturing space. This enlargement required a new hog-fuel storage building.

Next, because of the favorable location of the boiler house, a new one was built adjacent to it, retaining the old low-pressure boilers as spare capacity. The new plant has space for new boiler feed pumps, deaerating and closed feedwater heaters and storage tanks, water-test room and sanitary facilities. Provisions have also been made to extend the plant to install a second high-pressure boiler, after which the old low-pressure ones will be removed.

Fuel Requirements. Because of the uncertain fuel situation it is impossible to predict which fuel will be most economical in the future. Therefore, hog-fuel, oil and coal firing are provided for in boiler and furnace design. At present hog fuel is most economical and probably will be for some years. This fuel was selected for the new boiler with provisions for burning oil in emergency.

In future, coal firing may be the most economical so provisions have been



2 Steam-flow and pressure diagram. For one paper machine a 650-hp turbine drives a motor-generator set and exhausts against 100 psi. For the other machine, an 800-hp turbine drives a motor-generator set and exhausts against 65 psi

Turbine-Driven Motor-Generators

made in the plant design for burning this fuel. Space is provided for pulverizers, bunkers and coal-handling equipment. Oil burners can be replaced with a pulverized-coal burner and furnace bottom readily changed to take care of flyash.

The local public utility allowed a satisfactory rate that permitted power generation up to the steam limit required in the paper-machine driers. An interesting and flexible combination of equipment did the job. A dc motor drives each wet and dry end of the paper machines.

On one machine, power for these motors is supplied by a 550-psi 650-hp turbine exhausting to the machine's driers at 100 psi and driving a 300-hp synchronous machine and a 200-kw dc generator, Fig. 2. The other paper machine uses a similar arrangement, but the turbine is rated 800 hp and exhausts to the machine's driers at 65 psi. The 450-hp synchronous machine connects to a 300-kw dc generator. Turbine speed, which is 4065 rpm, is reduced through gears to 1200 rpm, the speed of motor and generator.

Synchronous machines connect directly to the plant's 2300-v power system, and may therefore act as a motor or generator, depending on steam requirements of the 100- or 65-psi steam systems. This system, in turn, is controlled by backpressure governing of the turbines.

The plant power system is protected by reverse-power relays so the synchronous machines can never pick up load outside the plant. An overspeed trip protects the turbine against overspeed if it loses its load or the synchronous machine trips off the power system. Backpressure control cannot reduce high-pressure steam to the turbine below a safe cooling limit. This prevents the synchronous machine from driving the turbine without steam in its casing and causing the machine to overheat.

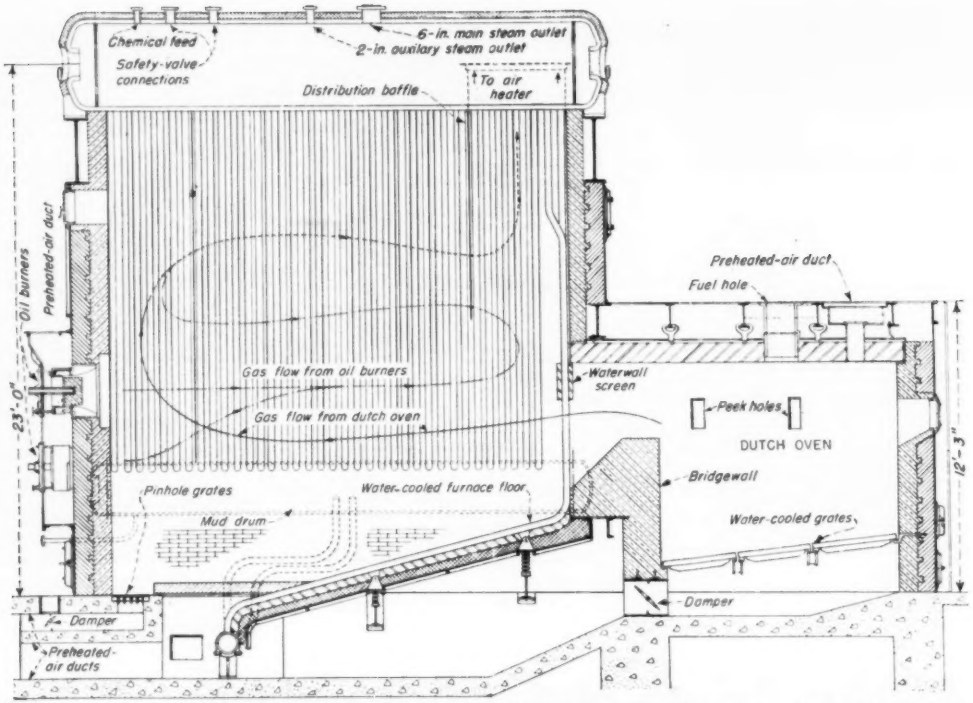
Low-Pressure Steam. In addition to supplying steam for the paper machine driers the turbines also supply medium-pressure steam for the boiler plant and process. The boiler has a turbine- and a motor-driven feed pump. Normally the motor-driven pump operates during the period when the building does not require heat, whereas the turbine-driven unit is used in the heating season.

Steam for the turbine-driven pump is taken from the 100-psi backpressure line and exhausted at about 5 psi into a line from which steam for the deaerating heater is taken. Water from the deaerating-heater storage tank goes to the feed pump at about 210 F and is discharged through a closed heater to the boiler. Steam for this heater, which is taken from the 65-psi backpressure line, drains to the deaerating heater.

Using steam turbines as reducing valves, as this plant does, produces the lowest-cost power of any generating system. Whether power was generated or not the paper machines would have required the motor-generator sets. Consequently, investment for power generation is chiefly for the reduction gears and turbines, the latter being a low-cost design.

The high-pressure boiler and piping cost only about 15% more than a comparable medium-pressure installation. Operating cost will be increased only a small amount. Because at no time does any exhaust go to atmosphere, over-all thermal efficiency is high. As a result every condition favors low-cost power generation.

New High-Pressure Boiler. The boiler is a 3-drum SA type, with 4545 sq ft of heating surface and 1700 sq ft of



3 A wall divides the dutch-oven furnace into two sections that operate as separate units. Each section is run as an independent furnace with its own fuel-feed hole, preheated-air ports and watercooled grates for high combustion rates

waterwalls, designed for 600 psi but operated at 575-psi and 725-F total temperatures. A tubular air heater supplies combustion air at about 500 F.

The superheater is installed in one side of the boiler. This position permits simple control of steam temperature. Each side of the boiler has a gas connection to the stack breeching. In each connection there is a damper. Differential operation of these dampers can control amount of gas passing through the superheater and, consequently, the steam temperature.

When the paper-machine turbines are shut down over weekends and holidays, steam is required for heating. This load falls within the quantity that can be supplied by the boiler's convection side, plus that produced by gas leakage through the damper on the superheater side. Under these conditions steam temperature is comparatively low, which simplifies the desuperheating problems.

Dutch-Oven Furnace. Hog fuel, containing about 50 to 55% moisture as fired, is burned in a dutch-oven furnace. For high combustion rates at good efficiency, moisture must be evaporated rapidly by radiant heat, from furnace walls and roof, and by preheated combustion air. To do this the furnace has been designed to (1) maintain high temperature over the whole fuel-bed area (2) rapidly evaporate the moisture and distill volatiles from the fuel (3) control underfire and overfire air (4) produce intense turbulence in the combustible gases and air (5) obtain long flame travel (6) direct the gas stream toward the inclined watercooled floor of the boiler furnace to sweep it clean of unburned wood char from the dutch oven.

The dutch oven, Fig. 3, may be considered a primary furnace and gas producer, separated from a secondary furnace under the boiler, but connected to it by a shallow throat. This throat is formed by a tile waterwall screen that drops down from the dutch-oven roof and a high bridgewall. Rear ends of the grates are about 4 ft back from the waterwall-screen tubes and about 5 ft below the top of the bridgewall. From its top the bridgewall slopes downward at a 45-deg angle. This wall supports the grate's rear ends and helps isolate the fuel bed from the boiler's heat-absorbing surfaces.

Watercooled Grates. A wall divides the dutch oven into two separate units. Each section operates as an independent furnace with its own fuel-feed hole, preheated-air ports and watercooled grates. The division wall between the halves of the dutch-oven furnace increases the radiant-heat surface to accelerate the combustion rate by maintaining a high temperature on the fuel bed's surface. This wall also permits cleaning the grates in one cell while carrying the boiler's steam load with the other.

Preheated air enters the furnace through holes in the suspended flat arch, which forms the dutch-oven roof, and through the watercooled grates under the fuel bed. Dampers under the bridgewall control under-grate air. Overfire air ducts also have dampers for air-flow control.

There is a large percentage of radiant-heat absorbing surface, which tends to distribute total heat absorption more uniformly over the boiler's entire heating surface. Large furnace volume under the boiler forms an ideal settling chamber for the wood char carried over from the dutch oven.

PRINCIPAL NEW BOILER-PLANT AND POWER EQUIPMENT

Westminster Paper Co, New Westminster, B. C.

STEAM-GENERATING EQUIPMENT:

Boiler, superheater, waterwalls, air heater ..... Foster Wheeler, Ltd
Boiler, 3-drum, SA type, heating surface 4545 sq ft, superheater, drainable; *waterwalls*, 1700 sq ft; *air heater*, tubular, 7040 sq ft; gas temp: in, 644 F; out, 422 F; max air temp out 497 F. Max continuous steaming capacity 45,000 lb per hr; 2-hr rating, 50,000 lb per hr; design steam conditions, 600 psi, 725 F; operating conditions, 575 psi. Furnace, dry bottom, volume 3200 cu ft, Btu liberated per cu ft per hr, 24,200
Boiler refractories ..... A P Green Fire Brick Co
Boiler heat insulation ..... Spun Rock Wools, Ltd
Boiler steel casing, ducts, breechings ..... Foster Wheeler, Ltd
Stack, steel ..... Western Steel Products Corp
30 ft high, 60 in. inside diameter

COMBUSTION EQUIPMENT:

Automatic combustion control ..... Bailey Meter Co
Soot blowers ..... Diamond Power Specialty Co
Dutch-oven furnace ..... Foster Wheeler, Ltd
Preheated-air design, divided by longitudinal wall, watercooled grates, furnace volume 1470 cu ft
Suspended roof-tile ..... Bigelow Liptak Corp
Watercooled grates ..... Olympic Foundry Co, Ltd
Ash gates ..... Foster Wheeler, Ltd
Cinder collector, multicone ..... Precipitation Co of Canada
Oil burners, 3, and oil heaters ..... F J Raskin
Forced-draft fan, vane control ..... B F Sturtevant Co of Canada
Motor driven, 25,000 lb per hr at 5.5 in. wg and 100 F
Forced-draft fan motor ..... English Electric Co of Canada
Splashproof, 40 hp, 1150 fpm, 440 v, squirrel cage
Motor starter, pushbutton ..... Canadian Controllers, Ltd
Induced-draft fan, damper control ..... B F Sturtevant Co of Canada
Motor driven, 100,000 lb per hr, 7.4 in. wg at 425 F
Induced-draft fan motor ..... English Electric Co of Canada
Splashproof, 100 hp, 1150 rpm, 2300 v, squirrel cage
Motor starter, pushbutton ..... Canadian Controllers, Ltd
Safety switches ..... Canadian Controllers, Ltd

VALVES, PIPING AND TRAPS:

Safety valves ..... Farris Engineering Corp
Nonreturn valves ..... Lunkenheimer Co
Blowdown valves ..... Yarnall-Waring Co
Drain valves ..... Hopkinson, Ltd
Steam-line gate valves and globe valves ..... Lunkenheimer Co
Pressure-reducing valves ..... Fisher Governor Co
Desuperheaters ..... Elliott Co
Feedwater valves ..... Hopkinson, Ltd
Piping insulation ..... Atlas Asbestos Co, Ltd
Traps ..... Yarnall - Waring Co

FEEDWATER SYSTEM:

Feedwater chemists, Hall ..... Northwest Filter Co of Canada
Feedwater chemical pumps ..... Hills-McCanna Co
Feedwater heater, Cochrane ..... Canadian Allis-Chalmers, Ltd
Deaerating 50,000 lb per hr from 65 to 220 F
Feedwater regulator ..... Bailey Meter Co
Water columns ..... Reliance Gauge Column, Ltd
Feedwater pumps, 2 ..... Warren Steam Pump Co
1 turbine- and 1 motor-driven, 50,000 lb per hr, 800 psi, 3550 rpm
Feedwater-pump turbine, 1 ..... Terry Steam Turbine Co
100 hp, steam conditions, 100-psi saturated, 5-psi backpressure
Feedwater-pump motor ..... English Electric Co of Canada
Totally enclosed, 100 hp, 2300 v, 3550 rpm, squirrel cage
Motor starter, pushbutton ..... Canadian Controllers, Ltd

METERS:

Boiler meter-and-control panel ..... Bailey Meter Co
Boiler instruments ..... Bailey Meter Co
Boiler meter (steam-flow air-flow), steam temperature and pressure recorder, flue-gas temperature recorders, 5-point draft gage, feedwater-level recorder
Steam-pressure gage ..... Mulcott Co, Ltd

POWER UNITS:

Steam turbines, 2 ..... Moore Steam Turbine Div, Worthington
one, 800 hp, 8-stage, 4065 rpm; 600 psi, 725 F, backpress 65 psi; one, 650 hp, 6-stage, 4065 rpm; 600 psi, 725 F, backpress 100 psi
Motor generators, 2 ..... Canadian General Electric Co
1 synchronous motor, 450 hp, 440 v, 1200 rpm; dc generator, 300 kw, 250 v; 1 synchronous motor, 300 hp, 440 v, 1200 rpm; dc generator, 200 kw, 250 v
Speed-reduction gears ..... Moore Steam Turbine Div, Worthington

Under the boiler the secondary furnace has a set of forced-draft pinhole grates on which wood char is burned as it accumulates in the furnace. A damper in an auxiliary preheated-air duct controls combustion air to these grates and the rate of burning the char.

Oil Burners. Designed to burn oil as a secondary fuel the furnace has three steam-atomizing oil burners in its rear wall. These burners have especially designed hinged registers. Thus the burner-vane assembly may be quickly retracted into a recessed box in the register plate, swung out, and a refractory plug quickly inserted when it is desired to switch from burning oil to hog fuel operation.

Conversely, if the hog-fuel supply fails, the expendable refractory plugs may be readily withdrawn or dumped into the furnace and the boiler quickly placed back in service to burn oil. This feature is important in plant operation because there is only one boiler.

Provisions have been made in furnace design so either a spreader stoker or pulverized-coal-burning equipment can be installed in place of the oil burners, should the oil supply become critical and uneconomical.

Grate-Cooling System. To prevent trouble because of scale, a closed cooling system with a heat exchanger is used on the dutch-oven grates, as in Fig. 2. It is desirable to operate the grates with maximum cooling-water temperature to keep heat loss at a minimum. The grate cooling-system comprises a large number of small copper tubes, making it necessary to recirculate pure water through them to prevent trouble from scale.

Water from the grates flows through a sight funnel to the heat exchanger, from where it passes to the circulating-pump suction. A small makeup tank with float-valve control supplies water as it may be required to make up evaporation from the cooling system. If the circulating pump fails, water circulates through the grates by gravity, leaving the system as vapor through the funnel. There is considerable foreign matter in Fraser River water, which might cause trouble if passed directly and continuously through the grates.

Control and Meters. The forced- and induced-draft and boiler-water level are under automatic control, but can be switched to manual operation. A boiler meter indicates, records and integrates steam flow, records air flow and steam temperature. This meter can be used as a fuel-feed controller when the boiler burns oil or pulverized coal as a primary fuel. A temperature recorder sets down flue-gas temperature. A 6-point draft gage indicates draft in the furnace, boiler uptake, air-heater outlet and secondary-air pressure.

POWER editors express appreciation to E M Herb, president of Westminster Paper Co, for permission to write this article, and to J Ashby, mill manager, W O Stevens, consulting engineer, and James E Neilson, Foster Wheeler, Ltd, for assistance in writing it.

NEW PHYSICIST MEMBER of the AEC is Princeton's Professor Henry De Wolf Smyth, the author of the famous Smyth report

GORDON DEAN, law professor at University of Southern Calif., and a practicing attorney, is another new member of the AEC

From Atom Bombs to Atom Power

With the atom-bomb program running smoothly, AEC now builds solid foundation for future atomic power plants. Condensed from the McGraw-Hill report by Bob Colburn of Business Week

►AFTER THE WAR America's atomic energy program pretty well fell apart. A year ago the project seemed to have passed its low point. There were signs then of a vigorous effort to correct the weaknesses and to get the program back on the track. By now, that effort is paying off.

Bombs—The atomic weapons' job is under control. Production is rolling smoothly; the supply of fissionable material should begin to increase substantially by the year's end. The bomb itself is somewhat more effective.

The appalling technical obstacles that still balked production improvement a year ago have now been reduced to tricky but clearly soluble engineering jobs.

Atomic Energy Commission is finally turning attention to the problem of power development. It has decided to start building several different types of atomic engines. These are still in laboratories and on drafting boards, but by the end of this year, two of them will be ready for programming.

Schedule—By about 1953, if all goes well, engineers will have proved that useful power can be produced by splitting uranium. They will know whether they can count on a plentiful supply of atomic fuel. And they should have the figures from which some reasonable estimates of eventual power costs can be calculated.

Then, some time in the second half of the nineteen fifties, an actual power plant should go into operation on a commercial scale and, possibly, with commercial costs. When that happens the atom will be in business.

If the costs are favorable that means atomic power will have real economic significance throughout the sixties.

More Plutonium for Bombs—The Atomic Energy Commission manufactures two kinds of atomic explosive—uranium 235 and plutonium.

The real problem absorbing AEC's attention has been the design and building of new plutonium plant at Hanford—a tremendous operation, on the same scale as the Manhattan Project jobs of building the original Hanford and Oak Ridge plants.

Chemistry—Only recently has AEC

considered itself out of the woods on this project. The difficulty has been in the chemical plant.

One of the most remarkable construction jobs in history is now going on at Hanford. Costing about a half-billion dollars, the new plutonium plant is probably the biggest building operation ever undertaken in peacetime.

Unlike the big construction jobs of the thirties, this is not primarily a matter of moving lots of dirt and pouring lots of concrete. This project involves precision work of a sort that would ordinarily be thought of as a toolmaker's job rather than a construction man's. Yet surprisingly, it has proved possible to do the work with construction crews.

Uranium 235 Again—One of the more surprising developments of the past year has been a marked increase in interest in production of the fissionable isotope, uranium 235, by separating it from the plentiful U-238. This is the operation performed by the gaseous-diffusion and electromagnetic plants at Oak Ridge.

A year ago AEC wasn't very excited about isotope separation. The electromagnetic separation plant at Oak Ridge had been shut down. The gaseous-diffusion plant was kept running, but there was no inclination to push expansion with any vigor.

Expansion—The change in viewpoint seems to have come after the Eniwetok atom bomb tests last summer. Perhaps the tests indicated that uranium 235 has a role to play that cannot entirely be filled by plutonium.

At any rate, within the last few months, AEC has set up this 3-way program to expand production of U-235:

1. An additional unit will be put in series with the gaseous-diffusion plant at Oak Ridge. This new plant, to cost about $70 million, will raise the purity of the U-235 from the existing plant and also increase the output.

2. In the works, though not yet formally approved, is a complete new diffusion plant to parallel the existing plant and provide additional capacity.

3. Carbon & Carbide, which operates the Oak Ridge plants, has begun work on a completely different and very promising electromagnetic process.

Bombs and Psychology—At Los Alamos, the New Mexico mesa-top where the bombs themselves are actually assembled, there has been little physical improvement of the working plant in the past year, but a tremendous improvement in town living conditions. As a munitions industry, clearly the atomic-energy program is now rolling very smoothly. Judging from the plans for increased production of fissionable material, production of bombs may be increasing. And it looks as if it could be practically doubled by 1950 or 1951.

AEC's Reactor Program—How about chain reactor development? Variations of all fundamental characteristics suggest hundreds of different types of reactors. There are the many combinations represented by different values of neutron flux, temperature, fuel enrichment, neutron speed. There are also the mechanical variations—different moderators, different coolants, different structural materials. And then there are all the engineering variations in the design of heat exchangers, pumping systems, control systems and the like.

The reactor engineers of the future will have a wide range of possibilities when they come to design reactors for specific jobs. Meanwhile, AEC's problem is to pick a few types of reactors to build. AEC has picked four.

Materials' Tester—One tough problem today, in design of high-energy reactors, is lack of knowledge of how structural materials will behave under terrific neutron bombardment. So one early project is to build the simplest possible high-flux reactor in which to test materials for other reactors.

The materials' tester is being designed at Oak Ridge and Argonne, will be built in Idaho. It will operate at a neutron flux very much greater than the Hanford piles. So even though it's not very large, it will develop a great deal of energy. In the interests of simplicity, however, it will be run cool. Cooling water will be passed through it at high pressure and terrific velocity in order to get rid of the energy without letting the temperature rise too far.

Also for simplicity, this reactor will run on slow neutrons, so it will use a moderator, possibly beryllium oxide. Yet it will use enriched fuels that will make it possible to load a lot of material into the test pockets without choking off the chain reaction.

The materials' tester will get under construction this year, will be finished in 1951 or 1952. It will cost about $20 million.

Breeder—the economics of atomic power will largely depend on whether "breeding" of new fuel is possible. So one of the new reactors will be primarily an attempt to breed, that is, to produce plutonium from U-238 faster than the U-235 content is consumed. The most promising way to do this seems to be to use fast neutrons; they are less easily absorbed in the structural materials, so neutron losses are at a minimum. That calls for use of very-much enriched fuel, and no moderator.

Since breeding will have only limited value unless you can do it in a hot power-pile, the breeder will be allowed to run up to high temperatures comparable to those of modern steam plants. That pretty much rules out water as a coolant; any reactor is tricky enough without having to use high-pressure steam pipes. So the reactor will be cooled with liquid metal with a very high boiling point—most probably sodium, alloyed with potassium to lower its melting point.

Sodium has good thermal properties and not much neutron absorption. It does become radioactive, but the radioactivity has a short half life. Metal has another cute advantage, it can be pumped electrically—by simply running it through a spiral pipe and letting the liquid itself be the rotor of an electric motor.

The hot metal from the reactor will be passed through a heat exchanger to generate steam that will make electricity. But the cooling system won't have the capacity to handle very much power.

The Argonne laboratory has had this machine on the drafting board for several years. Construction will start this year, will take until 1951, will cost only $3 million or so.

Submarine Engine—One of the strongest pressures for atomic power is coming from the military people; they want to use it to drive submarines and airplanes. They like the promise of almost infinite range without refueling. So one of AEC's high priority projects is now a power-reactor to drive ships.

The requirements are that the machine develop a lot of power in a small space and weight. Also, it must operate for months without chemical cleansing. That implies enriched fuel, perhaps combined with a moderator, plus extremely high temperature, perhaps as high as 2000 F.

Requirements call for use of unconventional structural materials like titanium and zirconium. This job is still in a preliminary stage. Argonne is working out the nuclear characteristics. Later, Westinghouse will do the actual engineering, perhaps start construction in 1950 or 1951, complete the job in 1953 or 1954. It is expected to cost some $30 million.

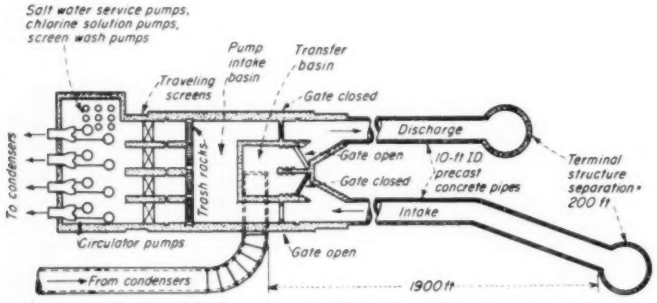
Power Plant—At Schenectady, General Electric is nearly ready to start construction of a pilot version of an atomic central-station power plant. This, it is hoped, will combine breeding with generation of substantial quantities of power. It will use enriched fuel, plus a small amount of moderator to keep the neutrons in an intermediate speed range.

The unit will be metal-cooled like the Argonne breeder, will operate at temperatures somewhat below those of a high-pressure steam plant. Completion is expected around 1952. Cost will run to about $18 million.

1 Circulating-water intake tunnel of Lynn Generating Station fouled up each year with marine growth. This is how it appeared in Nov 1946 after intermittent chlorination had been tried a year. Previous year had three times the accumulation

Chlorine and Heat Kill Marine Pests

Power stations using salt water for cooling have considerable trouble at times with marine life clogging intakes. Cost of clearing these accumulations, plus the loss in pumping power and efficiency, have led to developing methods of elimination



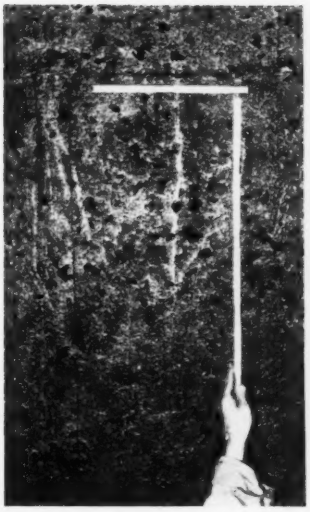
5 Redondo Station has system for reversing circulating-water line flow at will. Reversing four gate positions can make lines either discharge or intake tunnels

► A SESSION ON MARINE FOULING at the May 2-4, 1949 meeting of the American Society of Mechanical Engineers in New London, Conn., revealed some valuable and interesting information on the propagation and control of mussels. The papers comprising this session and forming the basis of this article are listed at the end under references, see page 162.

Mytilus Edulis. Marine organisms that foul up power-plant equipment using salt water may be divided into two classes: (1) Those that cannot move from the location to which they have securely attached themselves. (2) Those that can move from undesirable locations and reattach themselves in a more suitable environment. The first class includes barnacles, bryozoans, and algae, the second, common mussels and sea anemones.

Of all these types the common mussel, Fig. 3, has been the most difficult to control. The most rugged species has proved to be the edible mussel, Mytilus edulis. Any method that eliminates this type will also control any other form of marine-fouling pest. Hence most of the laboratory research has been made on this species.

Mytilus edulis thrives in enormous numbers in normal sea water with salinities as low as 15,000 ppm in "between tide" areas of more or less sheltered harbors and estuaries. Individuals may exist in water of lower salinity, but comparatively few survive. While mussel



2 Lynn tunnel fouling decreased to this extent in July 1947 with chlorination

3 Fouling in pilot tunnel without chlorination after one season in Oct 1948

4 Clean pilot-tunnel walls downstream from chlorinating point in Oct 1948

beds are also in waters of considerable depth in the ocean, the mussels found growing in intake tunnels are probably offspring of beds in shallow waters in the immediate neighborhood. The female Mytilus edulis may produce considerably more than a million eggs in a single season. The larvae are carried back and forth by tides and currents that distribute them widely. When they have grown enough to develop a foot they attach themselves to any convenient surface on which they are deposited. This usually occurs during late spring, summer and early fall. During the past winter, however, unusually heavy "sets" of mussels have been noted in December, January and February at Portland, Me., and Atlantic Beach, N. Y.

Ten months after attaching themselves as minute embryos, $\frac{1}{2}$ mm long, an individual specimen may grow to more than 50 mm long, 35 mm wide and 20 mm thick. In other words, an individual may grow a million times in bulk during a ten-month period. If the majority of such embryos live, a pint of them would weigh over 500 tons when matured, an awe-inspiring growth rate.

Screens at most water intakes prevent mature mussels from entering. Growths that do take place in the pipes and tunnels evidently originate with the unattached embryos that drift in with the water current. The problem then centers upon preventing such embryos from attaching themselves to the walls. Unfortunately, the young Mytilus edulis early in life develops strong resistance to unfavorable conditions. They can tightly close their bivalve shells for long periods to exclude obnoxious materials present in the water surrounding them.

These mussels have a single foot when developed beyond the embryo stage upon which they can move about. From a gland in the foot they can tie themselves to any object very firmly by means of "cables," resembling spider-web strands. Whenever water conditions become intolerable the mussel can cut these cables, called byssuses, and move to a new location at the rate of a few feet per hr. It does this by alternately extending and contracting its foot.

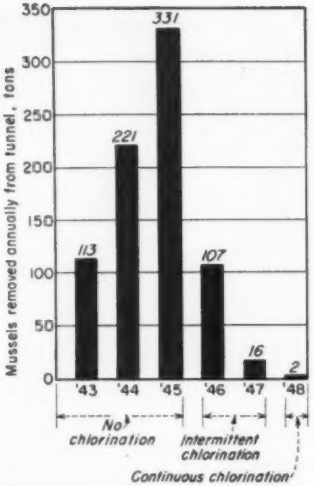
Small mussels about 4 to 5 mm long can sever their byssuses and float to new locations. This size can pass through most screens. Their floating ability is believed to stem from retention of a small bubble of air or gas within the shell. If disturbed while floating they release the bubble and sink.

Experiments. At Kure Beach Station, N. C., effects of chlorination were tried out on mussels of the species Brachydontes exustus. These grow profusely in Southern waters. Seven batches of these mussels, each containing from 50 to 100 specimens, were subjected to varying degrees of chlorination, as follows:

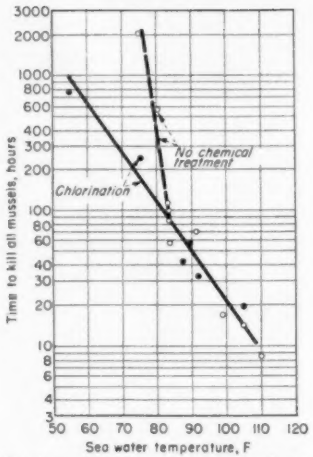
Batch No.	*Chlorine residual, ppm*	*Injection period*
1	0.00	None
2	0.25	Continuous
3	0.5	Continuous
4	1.5	2 hr on, 2 hr off
5	3.0	2 hr on, 2 hr off
6	1.5	2 hr on, 6 hr off
7	3.0	2 hr on, 6 hr off

These tests were conducted over a period of six weeks, results being observed at the end of each week, new specimens replacing those killed. All batches received a continuous flow of sea water from the same source during the tests. The No. 1 batch (control group) remained healthy throughout without chlorination. Continuous chlorination of batches 2 and 3 caused complete kills, and no other live organisms or slime was found in this treated water. In the batches intermittently chlorinated varying numbers, averaging about 50%, were killed and living barnacles and bryozoa were also found.

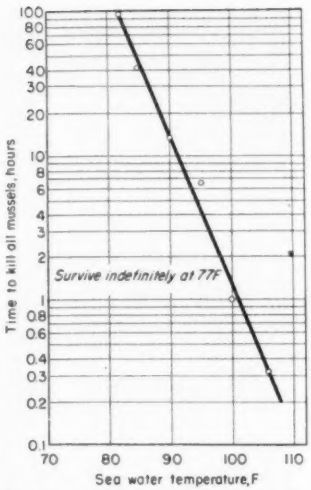
Temperature Effects. Another group interested in this problem conducted tests over a 2-year period with smaller groups of mussels, Mytilus edulis, where the action of individual specimens could be observed. All mussels and sea water were obtained from Lynn Harbor, Mass. In most of these tests the water in which the mussels were



6 Mussels removed yearly from Lynn tunnel decreased with chlorination



7 Above 85 F, Lynn Harbor mussels die in given time without adding chlorine



8 Young Pacific Coast mussels from Redondo Beach also die at raised heat

immersed was changed twice daily. For the tests with water temperatures above 88 F a continuous water flow was maintained.

Fig. 7 shows the test results indicating that very definite relationship exists between the sea-water temperature and the killing time for these mussels from Lynn Harbor. At temperatures below 85 F, chlorination shortens the killing time markedly. Above this temperature chlorination has no apparent effect. The killing time is controlled exclusively by the water temperature. The higher the temperature, the less time needed to kill all mussels.

Fig. 8 shows the killing-time vs water-temperature relation as determined by another group for young Mytilus edulis specimens taken from the vicinity of Redondo Beach, Calif. If these data are plotted on the same scale with Fig. 7, the curve lies below that for the Lynn Harbor mussels, indicating that the Pacific Coast species are apparently more sensitive to increased temperature. This may result from using only young mussels from the Pacific Ocean.

Practical Experiences. At the Lynn, Mass, generating station severe fouling of the circulating-water inlet tunnel occurred within a year of initial operation in 1929. Fig. 1 shows the complete fouling of the tunnel walls as they appeared in the fall of 1946. Since 1929 this tunnel has had to be cleaned once yearly. This procedure was costly in reduced station efficiency as well as labor for removal. From 1931 to 1932 intermittent chlorination was tried. But the concurrent appearance of corrosion-erosion of condenser tubes and graphitization of condenser water boxes coupled with uncertain mitigation of mussel growth led to its abandonment. Subsequently the corrosion troubles were traced to other causes.

Increasing accumulations in the tunnel, Fig. 6, led to trying again intermittent chlorination in 1946 and 1947. During the first year, chlorination was injected on the following schedule: 5 months—1 hr. twice daily, 0.2 ppm residual; 1 month—30 min every 8 hr. 1 ppm residual; 6 months—30 min every 8 hr. 2 ppm residual. The latter schedule was followed for 1947 with gratifying results but did not effect complete elimination of mussels as shown by Fig. 2, which was taken in July 1947.

Test panels submerged in the main tunnel gave inconsistent results on mussel growth. For better indications a small pilot tunnel was constructed in 1947 at the station, duplicating in miniature the layout of the main tunnel. The same sea water was passed through this pilot unit and given the same chlorinating injection. This gave an easy means to check results.

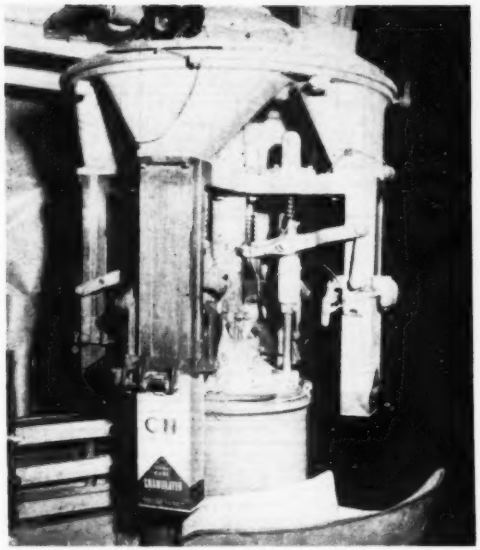
In April 1948 continuous chlorination was initiated with 1 ppm residual. After noting the favorable result in June 1948 the residual was reduced to ½ ppm. In Oct 1948, only a few mussels were found in the main tunnel, and it was estimated that no more than 2 tons would be collected if cleaned. Fig. 3 and 4 show the remarkable results of chlorinating in the pilot tunnel. Fig. 3 was taken ahead of the chlorinating point and Fig 4 after the point, some distance downstream.

Gross operating savings for 1948, consisting of tunnel-cleaning elimination, reduced condenser outages and cleaning, increased station efficiency, are estimated at $20,000. Chlorinating cost, consisting of cost of chemical and interest, taxes and depreciation on chlorine plant, when deducted from the gross saving, yields a net saving of $12,000 annually. This is felt to be conservative. Thorough analysis would probably produce other savings.

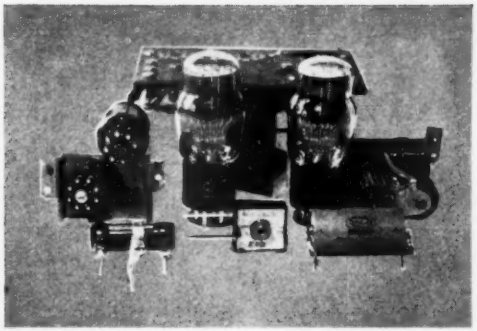
Redondo Station. This plant of Southern California Edison Co is on one of the most popular beaches in Southern California. The water intake and discharge had to be built 1900 ft into the ocean and built so a minimum of structure was exposed to wave action, especially in storms. Two 10-ft ID precast concrete pipes are laid under the beach with a minimum of 4 ft of cover. The lines cannot be unwatered. Terminal structures are vertical precast concrete towers, 14-ft dia, extending 10 ft above the sea floor and protected by rock riprap. Tops of the towers are about 20 ft below mean lower low water. They are separated by 200 ft. Fig. 5, to prevent cooling-water recirculation.

The shore end of each concrete pipe connects to a concrete structure with four vertical steel gates that can be raised or lowered by electric motors. By proper gate manipulation the pipes can alternately serve as intake or discharge. All four gates operate simultaneously, taking four minutes to com-

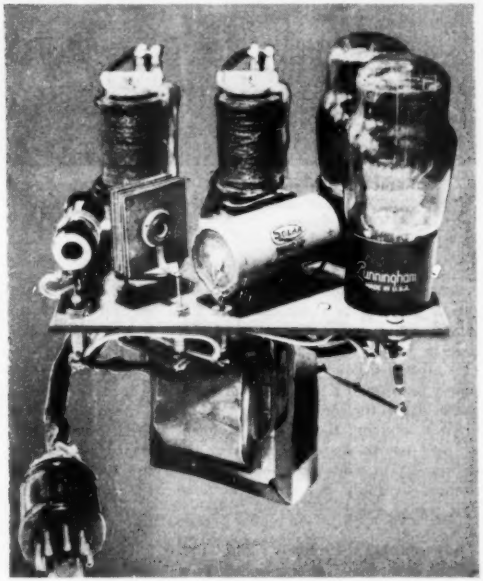
(*Continued on page* 162)



1 Vacuum-tube relays are incorporated into control circuits of this sugar-packaging machine reducing control failures



2 All components in the vacuum-tube relay rig are provided with plug-in tips to speed replacement when trouble hits



3 Two half-wave high-vacuum rectifier type-45 tubes are used. Total cost of each complete vtr unit is about $25

Motor Control With Vacuum-Tube Relays

Downtime was reduced when homemade vacuum-tube relay controls were rigged into multi-motored process equipment. Allen Beers at California-Hawaiian Sugar Refining Corp*, San Francisco, found control reliable and inexpensive

► It was probably because of the unique maintenance problem in a sugar refinery that we finally decided to adopt the vacuum-tube relay system for our motor controls. Our plant has some 650 motors ranging in size between fractional and 500 hp. We have a 2-phase 515-v system, in addition to the conventional 3-phase 440-v one: majority of motors are in the 3-phase group.

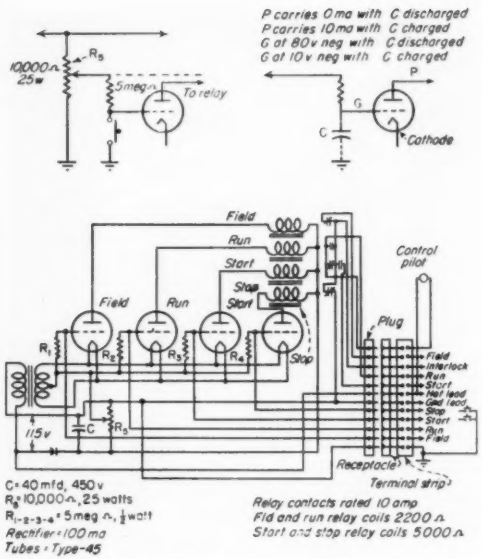
Original Motor Control. Many of our plant motors are interlocked in a starting and stopping sequence, which many times involves from two to seven motors. This is necessary to prevent the sugar, as it passes through the various stages of refining, from blocking or piling up at any point. In the past this interlocking was accomplished by tying in 440-v relays to the run side of the leading motor contactor. Often the control circuits for these interlocked motors branch out to several floors.

To appreciate the extent of our control system, it is worth mentioning that the long sugar conveyors have nine stop-button stations, and often they are located several floors from the motor and equipment they control. Needless to say, these stations are necessary for safety as well as to suit operating conditions. This spread-out control system necessitated running 440-v control circuits throughout the plant. Because it is a sugar refinery, there is always a certain amount of sugar dust in the air, regardless of the dust collectors that are in operation. We found out that this dust gets into the stop-and-start buttons, and in spite of constant maintenance eventually interferes with the contacts.

Considering that the power drawn through these circuits is about 450 watts, the button contacts, on opening or closing, will pull an arc. This in turn burns the sugar dust, resulting in a high-resistance contact which often runs

*Potrero Refinery

4 Each vacuum-tube relay unit is mounted in the motor contactor enclosure eliminating need for a separate cabinet



5 Schematic hookup for 4-tube vtr unit controlling 100-kva synchronous motor. Tie this in with circuits in Fig. 6

between a few hundred and a thousand ohms. Because the control circuits are spread out, it was not always an easy task to locate the source of trouble. This all boiled down to lost production, simply because of a high-resistance contact at one of the control stations.

After servicing the above equipment for over twelve years, we felt that the answer lay in converting these control circuits to high impedance circuits. This meant electronic vacuum-tube relays.

Advantages. Probably the first unique feature to be mentioned in a vacuum-tube relay control is that it uses but a single wire. This in turn reduces motor-sequence wiring to its simplest form. Then, again, since the power consumed in the vacuum-tube relay (vtr) circuit is of the order of micro-watts, there is essentially no sparking at the pushbutton contacts.

Another important advantage is the safety factor; because of the low voltage involved there is no possibility of the operator receiving an electrical shock. On top of that the fire hazard is reduced. This is important when the control wiring runs through hazardous areas where a serious fire could be started by the sparking resulting from shorts or grounds in the normal 440-v control circuit. It is a distinct advantage to have the 440-v confined to the motor circuit and contactor coils. Remember that these vtr circuits can be set for any tripping impedance from 1 megohm to 300, the limit being the highest value of insulation resistance that would be easy to maintain in the respective line.

Another point is that maintenance of these circuits is reduced to an insulation-resistance test. And, lastly, the problem of high-resistance contact in the conventional 440-v control circuit just does not come into the picture where vtr's are used.

Typical Installation. Fundamental equipment and assembly are shown clearly in Fig. 2 and 3. Schematic diagrams in Fig. 5 illustrate the use of vtr's in putting a 100-kva synchronous motor across the line. Incidentally, the control circuit is set to start or stop the motor, through any resistance up to 20 megohms which may develop in the circuit.

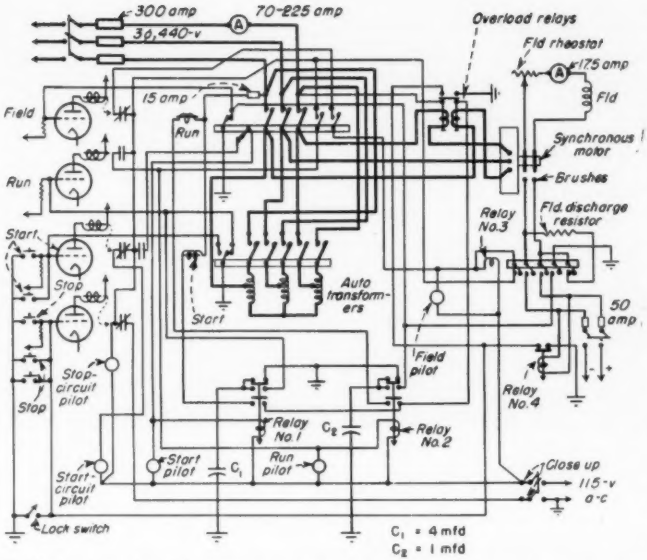
Filter condenser, copper-oxide rectifier, voltage divider and plate relays are all of the plug-in variety. On top of that, the complete vtr unit plugs in, assuring fast and easy repair when needed. Moreover, with a complete spare always on hand, down-time is reduced to a minimum. Many of these vtr controls have been in operation 5000 hours without a failure of any type. They are permanently installed on automatic trip scales and 5-lb paper-bag packers, Fig. 1, operating through rotating contacts whose resistance varies between a few ohms and several megohms. This change in resistance is due to sugar and sugar dust getting between the contact surfaces. The trip circuit of vtr's of these machines will operate through a resistance of 90 megohms at the contacts. To date the value of the contact resistance has never exceeded 10 megohms.

Current flowing in the start-and-stop circuits is approximately 16 micro-amperes. The resulting power is about 1280 micro-watts. It would be necessary in this case to have a contact resistance of 20 megohms to effect plate-relay operation.

Incidentally, the machine in Fig. 1 is a combination automatic scale and sugar packer. It has four arms that revolve and fill 32 five-lb bags of sugar per minute. To prevent the sugar going to waste via the chute below, when an operator misses an arm, a solenoid is set to lock the scale through vtr action.

Tube control-grid ties into a rail around top of machine. Brush contact rides on this rail connecting a wiping contact that follows the up-and-down lever action of bag holders. This wiping contact is a ground connection. If operator fails to get bag on the arm, control grid will be grounded, operating the solenoid.

Operating Details. Fig. 6 shows the control circuit for a 100-kva synchro-



6 Here's how the vtr's connect in with the synchronous motor's primary and field circuits. The starting sequence can be followed by noting the pilot lights

nous motor using vtr control. General procedure in putting this motor on the line is as follows: With the lock switch closed the 115-v ac control switch is first closed, allowing the vtr's to take over control. Notice that control grids of stop, run and field circuits are grounded, holding plate relays open. After pressing the start button the corresponding plate relay closes its contacts in the pilot-light circuit. Nevertheless, the pilot will not light since its circuit is not complete.

Next step is to close 125-v dc field switch, which energizes the dc relay connected directly across this line. Look back to Fig. 6 and notice how one ground is removed from the stop circuit when this relay is energized. Next preliminary step is to open lock switch, which removes the last ground on the stop circuit. At this point the pilot light on both start and stop circuits shows that motor is under control of vtr's. Incidentally, notice how the pilot lights follow each stage in the motor's starting sequence.

In normal operation the vacuum tube is biased to prevent flow of plate current. Looking at the start circuit for the moment, notice that pressing the start button grounds the grid circuit of the tube. After the start-relay contacts are made, the start-circuit pilot light goes out and the start-contactor pilot comes on. In addition, the 115-v ac relay (shown as relay No. 1 in Fig. 6) is energized, closing its contacts in the 440-v contactor coil. In addition to completing the coil circuit of the starting contactor, this relay connects capacitor C_1 in the grid circuit of the run tube. When the start contactor closes, the primary motor circuit is fed through the auto transformer. In addition to starting the motor, closing of the start contactor removes the ground connection from the grid circuit of the run tube and puts it on the corresponding point on the start tube. Keep in mind that the reason for using condenser C_1 is to prevent the run-relay from closing until condenser charges. This charging period is about 18 seconds. At the end of that time the plate relay in the run circuit closes, and through its contacts the run pilot light comes on.

At the same time, relay No. 2 closes to complete the holding coil circuit of the run contactor. Condenser C_2 is then disconnected from ground and hooked in on the grid circuit of the field tube.

In addition to putting motor across the line, closing of the run contactor releases the field tube grid from ground and puts C_2 on charge in its place. The closing action of the run contactor opens relay No. 1, dropping the start contactor out of the circuit. Notice how opening of relay No. 1 grounds condenser C_1. At the same time, opening of the start contactor disconnects control grid of starting tube from ground, while at the same time grounding control grid of run tube.

With the run contactor closed, relay No. 2 is sealed-in through the auxiliary contact on the run contactor. This action in turn holds the run contactor in.

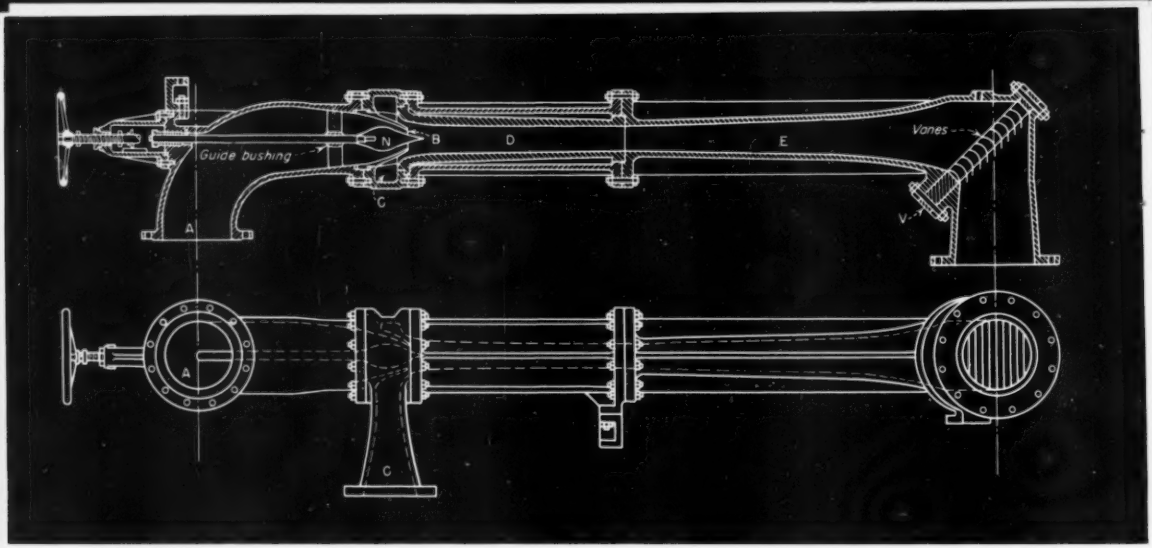
Condenser C_2 is charged in approximately six seconds, closing plate relay in the field circuit. In addition to lighting the field pilot lamp, relay No. 3 closes, opening field discharge resistance and connecting the synchronous motor's field to the dc source. Notice that closing of relay No. 3 seals its coil circuit in, making it independent of further vtr field operation. Once again the control grid, in this case of the field tube, is grounded.

At this point the vtr cycle ends. The proper field rheostat adjustment is made by hand after the synchronous motor is on the line. Motor operation is now under control of plate relay stop circuit, overload thermal devices, and grounding stop-contact of the dc relay. In addition, the lock switch is a potential means of stopping the motor.

Pressing the stop button opens the 115-v ground return from relays No. 2 and 3. When these open, all equipment will return to the normal de-energized position ready for the next cycle of operation. Looking back to Fig. 6, note that the motor cannot be started until the dc field supply is available. Notice that condensers C_1 and C_2 are grounded on both ends to avoid any possible partial charge remaining on them. An additional point worth mentioning is that tube failure, in fact any failure in the start or stop circuit, would be shown up by the pilot lights not coming on. From the above we see that any control-circuit failure would be noticed during starting period.

Construction Details. After many preliminary test runs, it was decided to assemble these vtr's in 2-tube units as in Fig. 2 and 3. The vtr shown in these photos may be plugged into any type across-the-line starter or wound-rotor induction-motor contactor panel. As already explained, it is also used to start and stop synchronous motors.

As far as assembly was concerned, it was decided to use a 6x4-in. panel as a base for each vtr unit. Using the best of materials, we found that each panel unit could be made up for approximately $25. As we look back on the picture over the past two years, it was this plug-in arrangement that sold the idea to plant management. They could readily see that the question of maintenance was reduced to a minimum, as well as any possible *down-time*, when the units could be replaced much as you would replace a fuse.



1 Cross section and assembly of a Grand Coulee jet pump. It is designed to discharge normally 2700 gpm at 50 psi, when it is supplied with 1800 gpm of high-pressure water under a 300-ft head and 900 gpm of suction water under a 5-ft head

Jet Pumps Cool Generators at Coulee

For air coolers in 120,000-kva generators, jet pumps use high-pressure water from turbine scroll case. This water lifts and mixes with water from tailrace to get desired quantity

By **J J BURNARD,** *Engineer, U. S. Bureau of Reclamation*

► AT GRAND COULEE the 120,000-kva generators have enclosed ventilating systems, complete with surface coolers. Fans on the generator's rotor force air through stator-core openings and to the surface coolers inside the generator casings where the air is cooled. Each generator, when operating at rated capacity, requires about 2500 gpm of water flowing through its coolers.

Economical Method. Comparative estimates were made to determine the most economical method of supplying this water. These estimates showed that pumping tailwater with a jet pump was more economical than throttling reservoir pressure with pressure-reducing valves, or pumping tailwater with motor-driven pumps. The jet pump makes this possible because of: (1) its low maintenance (2) saving in reservoir water from that required by a pressure-regulating valve, and (3) negligible electrical-power cost for operation, compared to a motor-driven pump.

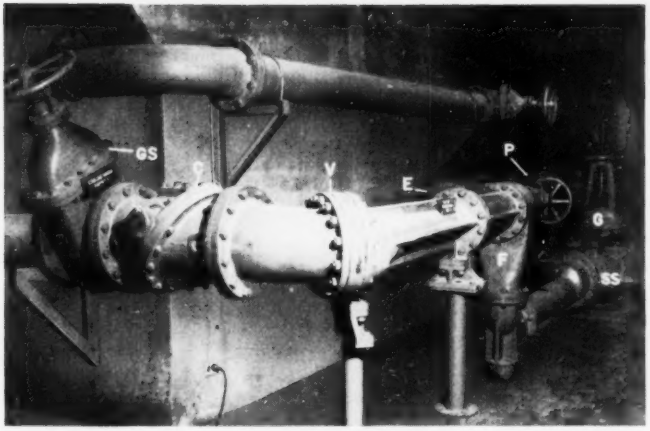
The jet pump is extremely simple because it has no parts that move during operation. For general power-plant applications its efficiency varies from 40 to 60%.

Jet-Pump Design. Fig. 1 shows a cross section and assembly of a Grand Coulee jet pump. When it operates, high-pressure water, entering at *A* and discharging at *B*, picks up suction water entering at *C* and mixes with it in section *D*. After transfer of momentum from the high pressure to the suction water has been completed in *D*, pressure is raised to the desired operating value in the conical diffuser *E*. At the end of the diffuser the vaned elbow *V* reduces flow velocity on the inner curve of the elbow to assist in maintaining high conversion efficiency of velocity to pressure head in the diffuser. Pressure on the cooling system and rate of water flow through it are hand controlled by needle valve *N* in the jet pump.

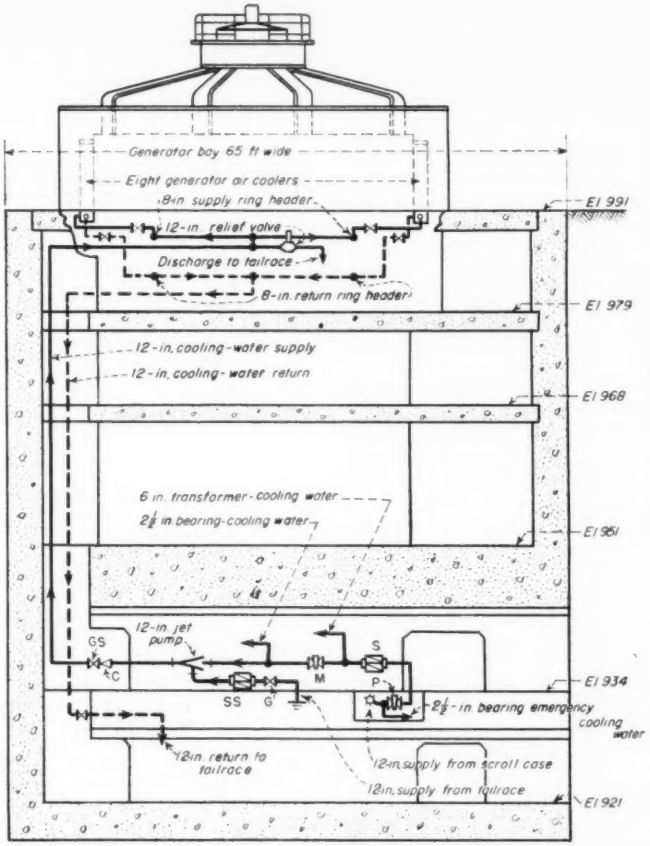
Grand Coulee jet pumps were designed to discharge 2700 gpm at 50 psi, when using 1800 gpm of high-pressure water at 318-ft head (136 psi) and 900 gpm of suction water at 5-ft head. Because of changes in reservoir level, jet-pump head may vary between 259 and 338 ft for the high pressure, and from 2-ft suction lift to 30-ft suction head for the suction water. Under low-head conditions the pumps were designed to discharge about 1300 gpm each at about 33 psi.

Generator Cooling System. Fig. 3 is a diagram of the generator cooling system. High-pressure water comes from the scroll case through a 12-in. line and goes through a hand-operated plug valve *P*, a twin strainer *S*, and a hand- or motor-operated plug valve *M*. This is the system's control valve, which can be operated either at the valve or from the switchboard. After passing through valve *M*, high-pressure water enters the jet pump and picks up water from the tailrace, through another 12-in. suction line. In this line are a gate valve *G* and a twin strainer *SS*.

When the water leaves the jet pump it passes through a check valve *C* and gate valve *GS*, and goes to an 8-in. ring header below the generator stator. Inlets of the eight generator air coolers connect to this header. Their outlets are joined to a similar 8-in. header, from which the heated water flows through a 12-in. line to the tailrace. A 12-in. relief valve on the supply line limits the pressure to 35 psi on the coolers.



2 High-pressure water comes into the jet pump through an elbow *E*, and the suction water enters the inlet housing *F*, which completely surrounds the nozzle



3 Diagrammatic arrangement of generator cooling system. Besides supplying water to generator, other connections go to transformer and bearing cooling systems

A 6-in. line for transformer cooling water comes off the main water-supply line between the motor-operated valve *M* and twin strainer *S*. Thus, transformer cooling water is supplied directly without going through the jet pump. The reason is that the intakes of the transformer's cooling coils are about 40 ft above the inlets of the generator coolers. Generator thrust-bearing cooling water is normally taken from between valve *M* and the jet pump, but in an emergency can be taken directly from the scroll case.

Jet-Pump Installation. Fig. 2 is a photo of the jet-pump installation. Pipe *P* is the high-pressure one with its hand- or motor-operated plug valve. The bottom pipe is the suction line from the tailrace with its gate valve *G* and twin strainer *SS*. Two pressure gages, not illustrated, show pressure on each side of the suction-line strainers and thus serve as a guide when cleaning is needed. The top pipe carries water to the transformers, the seal rings around the turbine-runner stuffing box, and cooler for turbine guide-bearing oil.

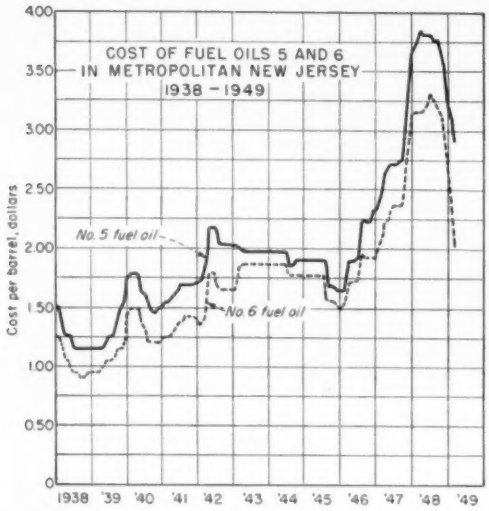
In Fig. 2 high-pressure water enters the jet pump through an elbow *E*. Coming up through the floor, low-pressure water enters the pump through a housing *F* that completely surrounds the nozzle. The elbow with diffuser vanes is at *V* and the supply-line check-valve and gate valve are at *C* and *GS*, respectively.

Jet-Pump Operation. Jet pumps for the first nine generators were built during the war when some materials needed in their construction were considered strategic. Consequently, it was necessary to use carbon steel in place of stainless steel for the nozzle shaft, needle and nozzle, and cast iron in place of manganese bronze for the mixing tube.

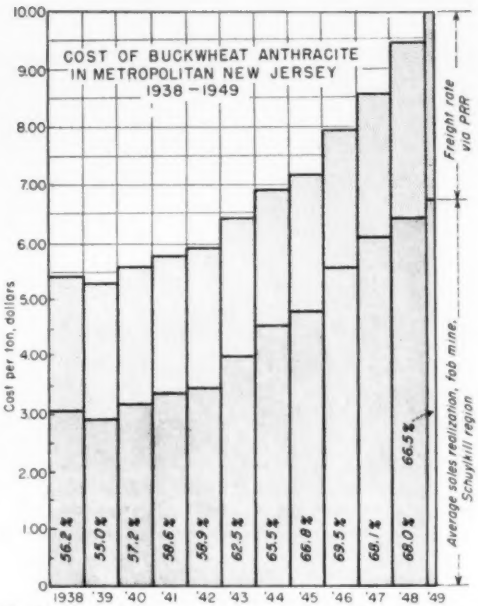
It was expected that the substitute materials would give some trouble. Maintenance has been negligible, however, during approximately 6½ years' operation. Minor pitting, caused by operating the pumps at too-low discharge pressures, has occurred in the cast-iron mixing tube. This condition has been remedied by a slight throttling of the discharge line.

In addition, there is a tendency toward corrosion on the carbon-steel shaft near the packing box and guide bushing. This has caused some difficulty in jet-adjusting-handwheel operation. These conditions are not serious and have been eliminated in later units by using materials called for in the original design. Considering the inferior materials, the jet pumps have given satisfactory service. They have easily met all demands as to pressures and quantities of water.

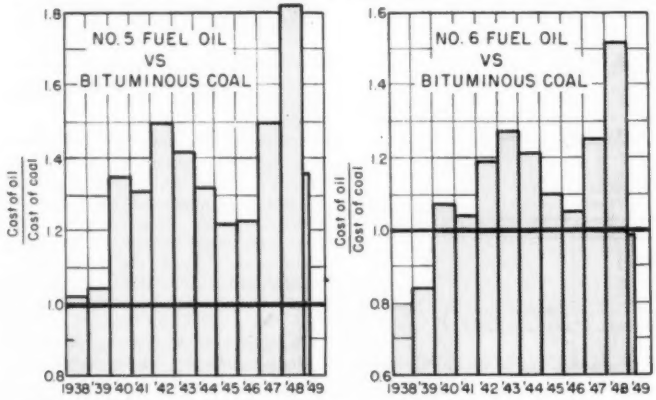
HOW FUEL PRICES VARIED


COST OF FUEL OILS 5 AND 6
IN METROPOLITAN NEW JERSEY
1938 – 1949
Cost per barrel, dollars
No. 5 fuel oil
No. 6 fuel oil
1938 '39 '40 '41 '42 '43 '44 '45 '46 '47 '48 '49

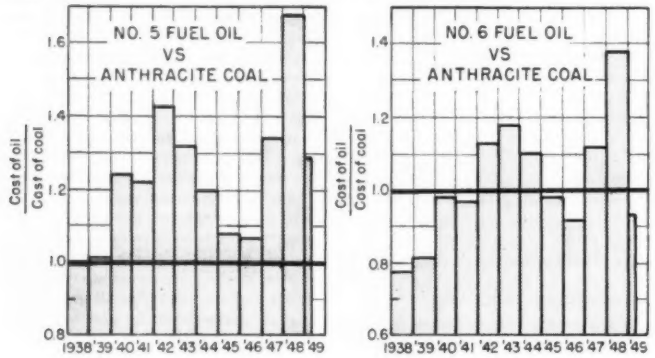
1 Fuel-oil prices rose spectacularly after wartime controls went off; dropped fast this spring when supply caught up



2 Cost of anthracite itself became an ever larger proportion of total until freight-rate rise took effect during 1947



5,6 How fuel oil has stacked up with bituminous (above) and anthracite (below). While coal has always been cheaper than No. 5 oil, No. 6 has an edge today



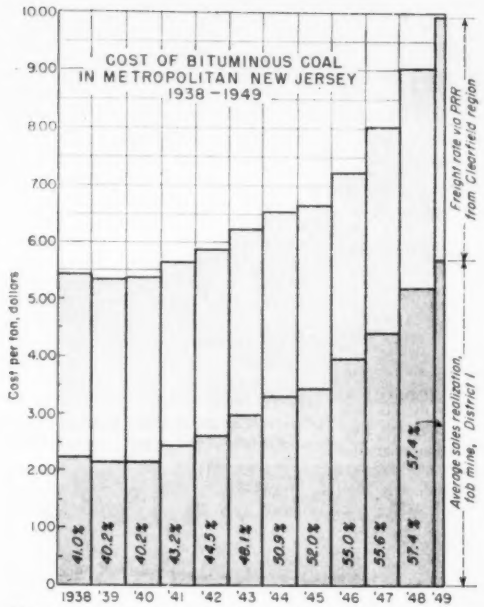
What's Been

Price trends of industrial fuels in metropolitan area of New Jersey reveal working of supply and demand forces, effect of changed postwar conditions

By **DONALD A LEVENSON**
Chemical Engineer
*Engineers Company, Inc.**

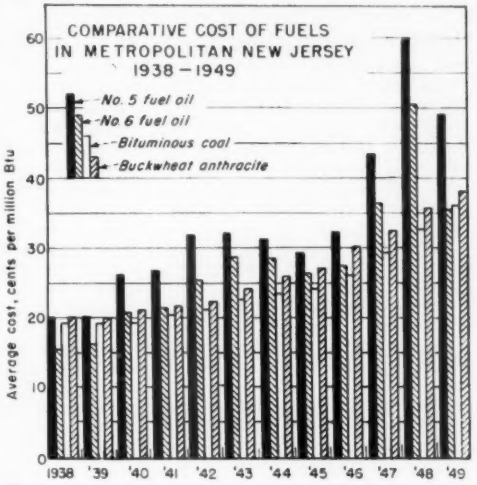
► WITH DRAMATIC SUDDENNESS, the New York harbor price of No. 6 fuel oil fell last February from over $3.00 per bbl to $2.05. In a space of weeks the relative position of oil and coal as industrial fuels in the New York area changed—from being about 60% more expensive than bituminous coal, No. 6 oil moved to a slightly better than even position. In varying degrees, this price change was reflected in other areas. What factors caused such a shift?

There isn't any simple answer to such a question. Even in a single area, rela-



3 Price of bituminous coal from District 1 shows same general rising trend as that for buckwheat anthracite, Fig. 2

EQUIVALENT COSTS COMPARED


COMPARATIVE COST OF FUELS
IN METROPOLITAN NEW JERSEY
1938 – 1949
No. 5 fuel oil
No. 6 fuel oil
Bituminous coal
Buckwheat anthracite
Average cost, cents per million Btu
1938 '39 '40 '41 '42 '43 '44 '45 '46 '47 '48 '49

4 Cost of four common fuels in metropolitan New Jersey compared on equivalent Btu basis; no allowance for efficiency

Happening to Fuel Prices Since Prewar?

tions between prices of competing fuels are complex. Because transportation costs play such a large part, comparisons between one area and others prove even more difficult. Yet an understanding of some of the major forces at work can be gained from studying fuel-price movements in a given locality. Once gained, such an understanding of price factors will help in examining other situations.

Price Trends. For this reason, power engineers should find the figures given here of real interest and value. The charts compare, for the years 1938 through 1948 and the first quarter of 1949, prices of four fuels used for industrial purposes in the metropolitan New Jersey area: No. 5 fuel oil, No. 6 fuel oil, buckwheat anthracite and bituminous. Remember we are dealing with *fuel prices only*, not with operating costs and investments required when these fuels are used.

Fig. 1 shows cost of fuel oils No. 5 and 6 (bunker C) in metropolitan New Jersey (Source: Reference No. 5). These prices are actually fob New York harbor and do not include taxes and inspection fees. Transportation charges from seaboard terminals to points of use in this area, and taxes and other fees are, however, insignificant when considered on a per-barrel basis. The curves show a gradual prewar rise, relative steadiness during controlled wartime conditions, a rapid rise postwar and a precipitous drop this spring.

Fig. 2 shows cost of buckwheat anthracite delivered to this area (1, 2, 3). This cost is, of course, made up of two parts: (1) cost of coal at mines (2) freight charges. Total cost rose during the period. Through 1946, however, freight charges did not increase materially. Thus cost of the coal itself represented an ever larger proportion of the total until the railroads were granted a substantial increase in freight rates. Note that coal prices given are *average sales realization figures*. For 1948, the figure is an accurate estimate; for the first quarter of 1949, it is approximate.

The trend for bituminous coal, Fig. 3, is similar (2, 4, 8, 10). Coal originating in U. S. District No. 1 is used as a basis, since this area furnishes by far the greatest amount of coal consumed in New Jersey (7). It is an interesting fact that average sales realization of bituminous in District 1 ranges from 10 to 50¢ per ton higher than the average for all U. S. bituminous (4). This sidelight does not, however, affect interpretation of the curves as far as metropolitan New Jersey is concerned.

For cost comparisons between fuel oil and coal, figures must be reduced to an equivalent basis. We assume here that bituminous has a heating value of 13,800 Btu per lb "dry" and that anthracite has a heating value of 13,200, also on a "dry" basis. For No. 5 fuel oil, we take 148,000 Btu per gal as the heating value, with 152,000 as the value for No. 6 oil.

Cost Comparison. Comparison of the four fuels on an equivalent Btu basis is shown in Fig. 4. Note that coal prices have risen gradually while oil prices have varied more widely. No. 5 fuel oil has always been considerably more expensive than the other fuels. No. 6 oil, however, has been much higher than coal for only a relatively short period and has been lower on several occasions.

Fig. 5 and 6 reveal the trend in comparative costs more clearly. These charts show the relative costs of the two fuel oils compared with each of the coals, on an equivalent Btu basis. Here

(Continued on page 164)

*Now associated as chemical engineer with Industrial Process Engineers, Newark, N. J.

SPEAKING OF POWER

One of the first experimental gas turbines specifically designed for pipeline service will be built for Tennessee Gas Transmission Co jointly by Clark Bros Co, Inc, and Frederic Flader, Inc. With an expected thermal efficiency of more than 30%, this gas-fired unit will develop 5500 hp to drive a centrifugal compressor on the Tennessee Co's gas line near Moorehead, Ky.

Primary purpose of the installation is to test the possibilities of high-output high-efficiency gas turbines as prime movers for long-distance transmission of natural gas. According to C Paul Clark, president of Clark Bros, newer designs of gas turbines not only permit smaller foundations and buildings, with resulting savings in installed cost per hp, but also offer future possibilities of greater fuel savings. Gas turbines, since they do not require cooling water, should also be particularly useful for the desert country through which many pipelines run.

★ ★ ★ ★

One of our good friends in the pump business tells this one: He recently received a letter from an Egyptian customer about the crates in which pumps are packed for export. "You stencil *This Side Up* in seven languages," he said, "but most of the dock-wallopers who handle your crates can't even read one." For the benefit of other export shippers, the solution to the problem of the illiterate stevedore is painfully simple. Just paint a bottle on the side of the crate. Then everyone knows which end is "up."

★ ★ ★ ★

America's first train to be fueled by oil made from coal carried visitors from St. Louis to the dedication ceremonies of the Bureau of Mines' coal-to-oil demonstration plants at Louisiana, Mo. Synthetic diesel fuel for the Burlington Route diesel locomotive—some 1200 gal for the 188-mile round trip—was produced as part of an initial 2-day run in the coal-hydrogenation plant. Official automobiles in use at the plant site on dedication day also operated on synthetic fuel—gasoline from coal.

★ ★ ★ ★

For those interested in records, here are some figures to compare with those of the Tacubaya Diesel Plant (pp 72-77). First as to engine size: much larger units have been built in Europe—up to 22,500 hp—but these 8650-hp engines are largest yet built in the U. S. As to plant size: the installation in the French Concession, Shanghai, has generally been considered the world's largest oil-burning diesel plant. It was rated at 51,200 hp when last heard from. Tacubaya's 51,900 hp at sea-level rating wins by a nose, but the picture is reversed if we base the comparison on actual capability—44,100 hp at Tacubaya's 7500-ft altitude.

The largest oil-burning diesel plant in the U. S. is at Vernon, Calif. Five 7000-hp units give a total of 35,000 hp. If we bring gas-burning diesels into the picture, the palm goes to the Reynolds Metals Co installation near Hot Springs, Ark. In one part of this plant there are 18 gas-diesels, rated at 3600 hp each, for a total of 64,800 hp. In another section, there are 50 spark-ignition gas engines of 1165 hp each. This brings the grand total up to 123,050 hp, or 78,000 kw—by far the world's largest internal-combustion-engine installation.

Even this title is tottering. Aluminum Corp of America's new Texas plant is now planned for 120 units, each of 1800 hp or 1150 kw, net. This adds up to—hold your hats—216,000 hp, or 138,000 kw. These will be spark-ignition engines burning natural gas.

That's the way it looks from where we sit. Other entries for the world's internal-combustion-engine championships will be welcomed.

★ ★ ★ ★

People who fool around with advertisements printed in scented ink seem to wind up in trouble of one kind or another. We told you (Jan) about the remarkable results of a perfumed cosmetic ad. Apparently undeterred by the widely publicized effects of that one, another newspaper recently printed a bakery ad with ink smelling deliciously of cinnamon. It might have helped the sales of buns but when the papers hit the suburban porches all hell broke loose. It seems that the scent of cinnamon drives dogs crazy!

★ ★ ★ ★

Ever wonder what editors do in their spare time? We can report on what at least two of POWER's staffers will be doing for the coming year: Associate Editor Ben Skrotzki will head the AIEE's Power Generation Committee and Executive Editor Lou Rowley will serve as chairman of the ASME Oil and Gas Power Division. Not content with these substantial extracurricular chores, the boys will team up on another one. They've accepted an invitation to present a paper on American gas-turbine practice at the World Power Conference to be held in London next July.

I WISH I HAD . . . .

A good friend of ours told us the other day that he thought many power engineers were "frustrated." These power engineers, he said, can't find among the many products and materials now available the exact things they need to solve some problem, eliminate some operating headache. The frustration comes in, he went on, because there are no convenient channels by which these needs can be made known to manufacturers and researchers who might do something about them.

At that point, he gave us a dirty look and said it was a job that POWER ought to be doing. Frankly, we don't know. When we put our new-equipment department together each month, there certainly seems no dearth of new or improved products and materials. On the other hand, when we talk to one of our power-engineer acquaintances, it's quite likely that somewhere in the conversation, a sentence will start like this, "You know, I wish I had . . ." and then go on to name some specific device that would make life in the plant simpler and operation more efficient. We wouldn't go so far as to say that any of our friends are frustrated, but there do seem to be some things they would like to see made available commercially.

So, with a completely open mind, we'd like to try an experiment. We'd like to have your help in it. Think about what our friend said. Do you need some new product or material to solve a problem in your plant? Do you find some *general* lack in a particular type of equipment? If you do, drop us a line, telling what you suggest and why it's needed. Please make your suggestions specific. Don't ask for obvious impossibilities, however desirable. Don't call attention to defects of one make or model of equipment. Your recourse on that lies direct with the maker. On the other hand, if all left-handed widgets are difficult to get at for maintenance, then *all* makers of widgets should know about it.

If your response indicates a need for a forum to discuss this kind of thing, we'll consider providing it in POWER and will see that suggestions get the attention of manufacturers. So, let's have your reactions to this scheme. Maybe our friend had a good idea.

4500-HP GAS-TURBINE LOCOMOTIVE pulls load of freight on test run; 500,000-lb unit is geared for 79 miles per hr

EACH NIGHT DURING TEST RUNS the prime mover and locomotive is checked for results and readied for next day's run

► THE GAS-TURBINE LOCOMOTIVE built by American Locomotive and General Electric has undergone track tests since Nov 1948. It has hauled freight trains over several thousand miles and will soon be tried in similar service, but on a revenue basis, on the Union Pacific Railroad. It will then run under a wide variety of conditions from low-altitude desert to rugged mountain territory.

On a recent visit we had a chance to inspect and ride this new unit. Here are some impressions: We first saw the locomotive standing on the 4.8-mile test track at GE's Erie, Pa. works. After climbing around in the compactly arranged but not overcrowded interior,* we stood by while the unit was brought up to operating condition from cold. The starting diesel, unmuffled, winds up with a roar. As turbine and compressor come up to speed, their inlet and exhaust noises merge with that of the diesel. The sound shifts to a higher pitch. Most of the noise comes from the turbine exhaust discharging at about 150 mph.

The warmup took only a few minutes. We found the operator's cab comparatively quiet and the entire interior cooler than might be expected with 1300-F gas doing the work. The locomotive started imperceptibly and accelerated with velvet smoothness. In less than two miles we were doing 60 mph, "rolling light."

The operator controls speed by rate of fuel feed to the combustors and simultaneous adjustment of generator excitation. He has close control and good response from the unit. It can be "inched" along the track for precise positioning. General setup of controls closely resembles the now familiar diesel-locomotive arrangement.

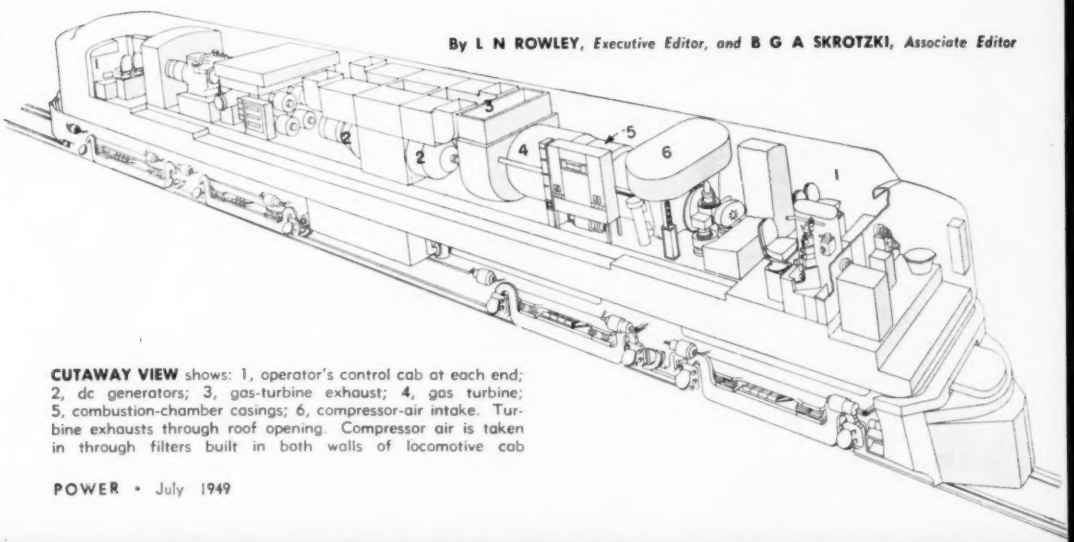
Seen from trackside, the loco rolls past without a sign of smoke; only a haze above the cab roof reveals the hot turbine exhaust. Exhaust noise falls off quickly as the unit passes; it can't be heard 400 ft away.

This first gas-turbine locomotive to ride US rails represents a real stride forward in development of this form of motive power. But it is the first of many still to be made. No one knows this better than the builders, who anticipate that many more months of exacting road tests will be needed to prove the unit for commercial service.

*See POWER, Jan 1949, p 134; May 1948, pp 95-98; Aug 1947, pp 68-70.

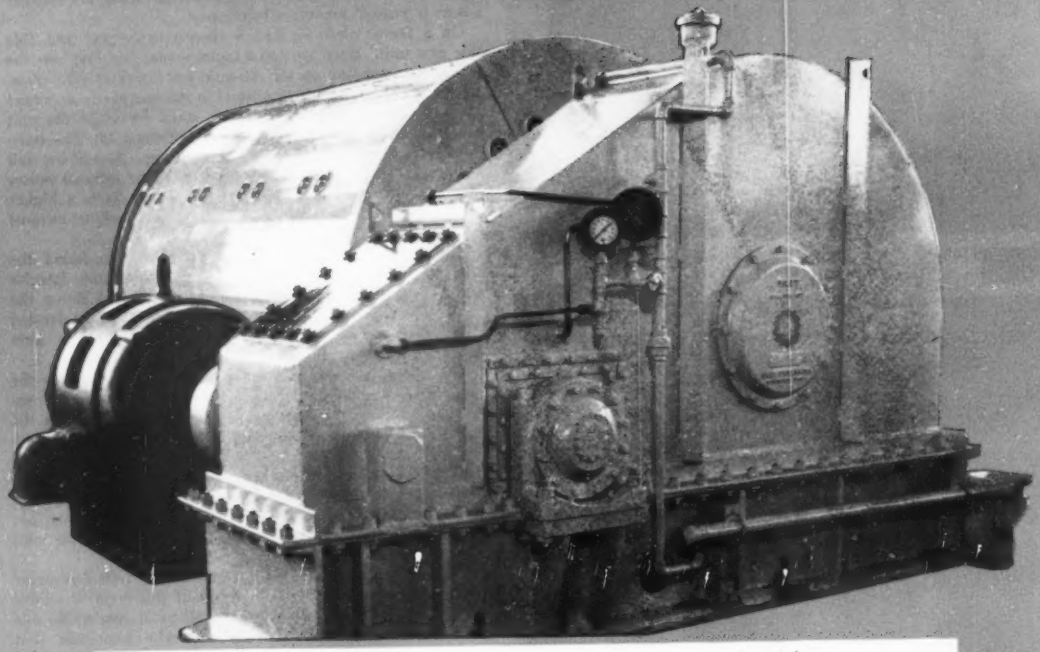
First U.S. Gas Turbine Loco Rolls

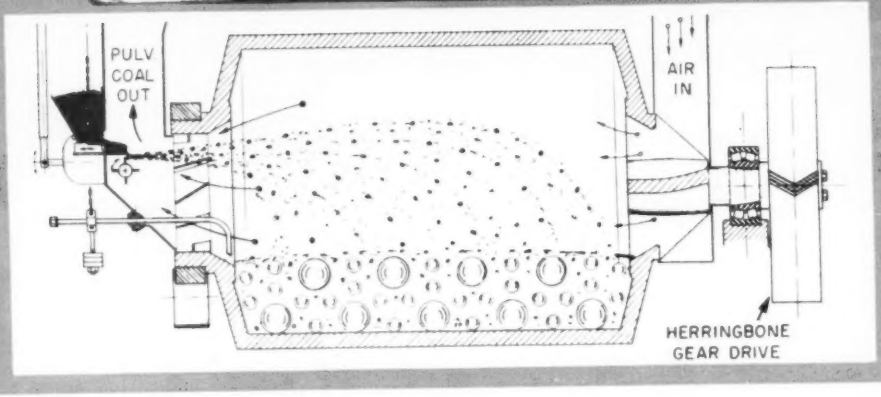
By L N ROWLEY, *Executive Editor, and* B G A SKROTZKI, *Associate Editor*



CUTAWAY VIEW shows: 1, operator's control cab at each end; 2, dc generators; 3, gas-turbine exhaust; 4, gas turbine; 5, combustion-chamber casings; 6, compressor-air intake. Turbine exhausts through roof opening. Compressor air is taken in through filters built in both walls of locomotive cab

Years of Continuous Pulverizer





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Operation with the *NEW* RILEY *ball tube mill*

PATENTS PENDING

Many Distinctive Design Characteristics assure greater ball tube mill performance than ever before

COMPLETE RELIABILITY. The sturdy all steel construction, the accurately machined double herringbone gears, automatically lubricated, and the rugged self-aligning roller bearings used with the Riley Ball Tube Mill assures complete reliability and years of continuous operation without shutdown for maintenance. Fineness of pulverization is maintained at all times merely by maintaining the ball charge. Tramp iron or other foreign matter in the raw coal does not effect the pulverizer in any way.

LOWEST MAINTENANCE. Maintenance of the Riley Ball Tube Mill is extremely low consisting almost entirely of maintaining the ball charge and an occasional replacement of exhauster fan blades. All major parts of equipment—liners, gears, etc.—have a normal life of over ten years.

LOW POWER CONSUMPTION. Power consumption with the Riley Ball Tube Mill is from 10% to 20% lower than with ordinary mills of this type and at or near full capacity, power consumption is lower than with many other types of pulverizers. Low operating power results from the use of a three point suspension system in self-aligning anti-friction bearings, high efficiency herringbone gear reducer drive and the method of feeding coal and air to the pulverizer. An automatic type clutch coupling between pulverizer and drive motor permits the use of standard constant speed, normal torque high efficiency type drive motor.

ABILITY TO HANDLE HIGH MOISTURE COALS. The Riley Ball Tube Mill will handle high moisture coals with but little reduction in capacity. The high capacity reduction with increased moisture of the ordinary ball tube mill does not occur because coal is fed in suspension permitting effective drying in a counterflowing preheated air stream of automatically controlled temperature to meet prevailing drying requirement. Since coal is spread over full pulverizer length and not concentrated at one end of pulverizer, the tendency of coal to cake is minimized.

SMALLER IN SIZE AND WEIGHT. By using all steel construction, the over-all size and weight is materially reduced. Counterflow of air and coal, and the unique method of distributing coal uniformly over the full length of the pulverizer, thus providing uniform feed to a uniform ball charge thereby making full use of all grinding elements, result in a greater coal pulverizing capacity for a given size of mill. Riley Ball Tube Mills can consequently be installed where space is restricted. Smaller foundations are also required.

The New Riley Ball Tube Mill together with the improved Riley Atrita Pulverizer, (now available with tungsten carbide wearing parts and other new developments), enables Riley to most effectively meet the requirements of all conditions involving the use of pulverized coal.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

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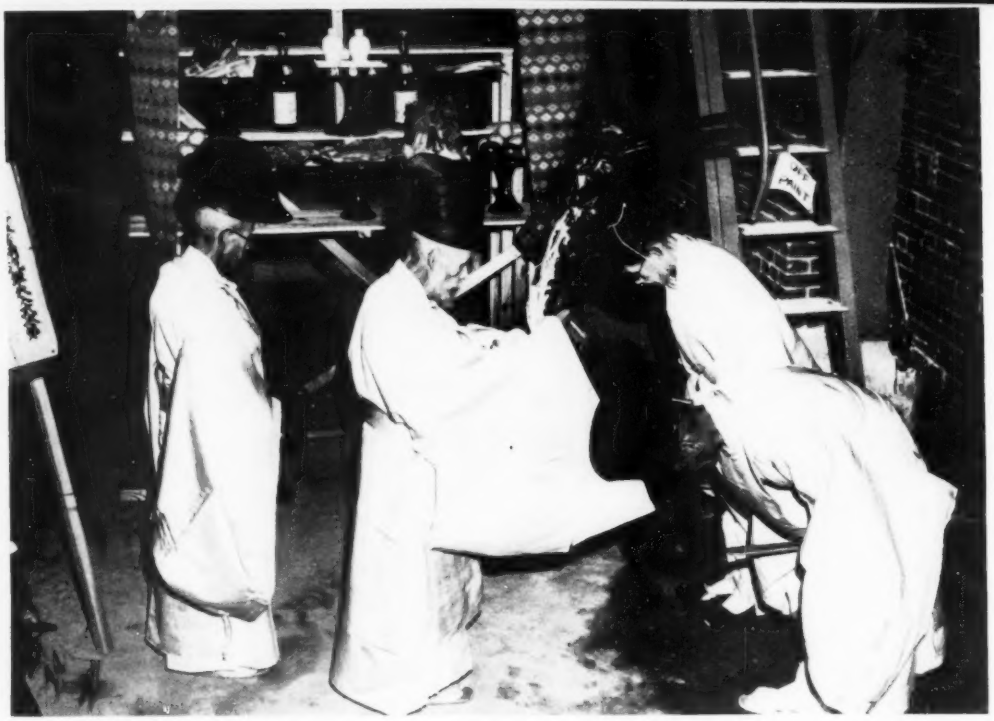


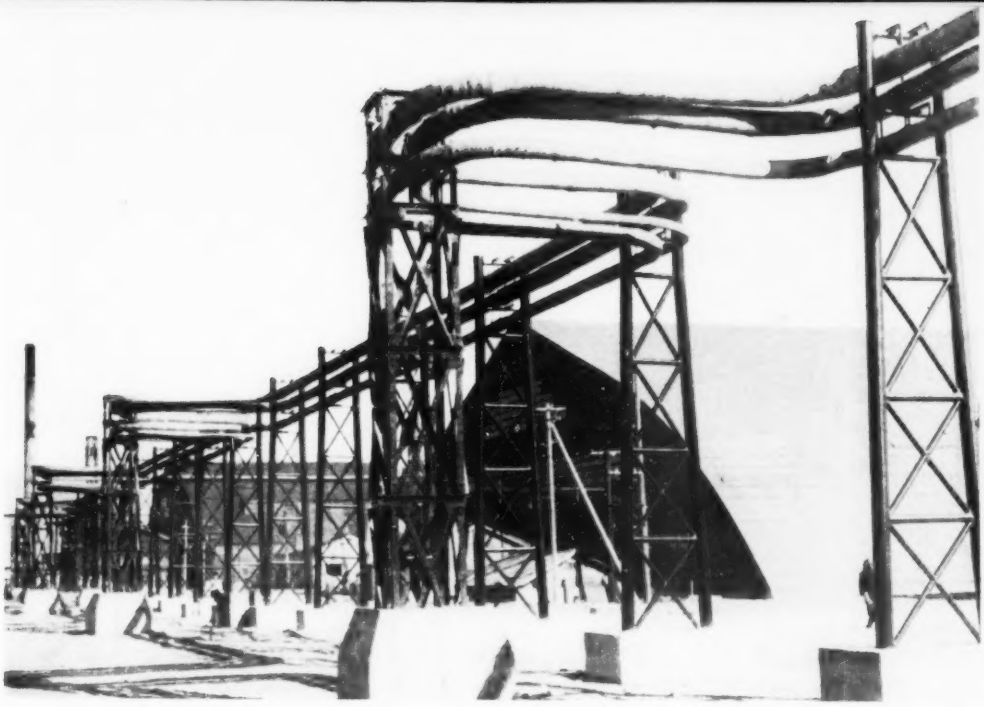
SHINTO PRIEST WAVES LEAFY BRANCH to dispel evil spirits as part of ceremony at lighting-off of new heating-plant boilers

Home Was Never Like This, or . . .

BALANCED ON POLE SCAFFOLD these Japanese laborers work on installation of the Haneda heating system. (Note from the safety department: Please don't copy!)

► THERE'S A POPULAR SONG going the rounds that deals at length with the romantic fascination of strange lands and customs. You know it—the chorus begins something like this: "Fa-ar-awa-ay pla-aces . . . tum-ti-tum . . . strange-sounding names. . . ." It began to sound more like the real thing and less like Tin Pan Alley malarkey when we picked up a recent copy of the newspaper put out by MATS—Military Air Transport Service to you. This carried pictures (above and left) and a story about the Air Force base at Haneda, Tokyo, and its new heating system.

Where do the Shinto priests and the pole balancers come in? Well, that's what we asked our editor in charge of strange lands and customs. He didn't know either, but being more resourceful, he got in touch with headquarters. In this case, that's the Public Information Office at the Haneda base. To them we're indebted for: (1) the pictures (2) some facts on what you do with heating-system piping when the water table is only one foot below grade, and



DISTRIBUTION MAINS run overhead to save costly tunnel work on an island where water table runs about a foot below grade

Nippon Puts Heating Plant on the Line

(3) some interesting slants on how Japanese practice compares with American in respect to that good old custom of dedicating new plants.

Haneda, like other Air Force bases, comprises offices, workshops and billets. Unlike others, it is on a partially man-made island, with water level so close to grade that it's practically awash. The former heating system was strictly a local affair—a number of small boilers, each serving one or two buildings. The 584th Engineer Construction Group, charged with modernizing this system, decided in favor of a centralized design, to save manpower and maintenance costs. They built a new heating plant, housing four 5000-sq-ft watertube boilers and necessary auxiliaries, near the consolidated mess.

When it came to distributing the output of this plant to the various buildings of the base, this business of the water table came into the picture. Underground piping, while neater, would have required costly concrete tunnel construction. So, under pressure of practical considerations, and who knows what Air Force propaganda, they took to the air with the piping.

Thus far, all this comes under the heading of "standard operating procedure"—just good common sense American engineering. The pole-balancing act to the left, however, represents a strictly Japanese contribution. The pole scaffold used by the workers certainly has the virtues of simplicity and ease of erection, but all we can say is "don't let the safety department catch you!"

A further contrast in methods pops up when we take a look at the dedication program. Most of us know the American routine—speeches, inspection trip, turning the throttle wheel or lighting-off the boilers, and luncheon. Simple, dignified, perhaps just a mite colorless. In one respect, at least, the Japanese program is the same—the lighting-off. But before that, a world of difference.

The Japanese dedication is essentially religious, and is in charge of Shinto priests. It begins with the high-pitched tones of a *hue*, an instrument resembling a flute, and a pair of *shoohichirikis*, somewhat like miniature pipe organs. Men in bright-colored robes play these instruments, while white-garbed priests bow before a stand laden with offerings to the God of Fire—food, fruit, wine (see picture).

After the first priest finishes his invocation, a second waves a leafy branch over the boilers, the musicians and the group assembled to witness the ceremony. This is calculated to drive off any evil spirits that might inhabit the area.

To insure the safety of the workers who will tend the boilers, a third priest then sprinkles bits of paper over the firing doors and boiler fronts.

At this point, Japanese and American practices merge. A fourth priest ignites the first fire with a flaming torch and the first shovelful of coal is thrown on the blaze. At the Haneda dedication, Col Frederic A Henny, commanding the 584th Engineer Construction Group, performed this final ceremonial.

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Here's the new general-purpose turbine that meets the increasingly rigid demands of modern industry. Wrapped up in one *standard* unit are the best features of previous Westinghouse drives . . . plus important refinements and new developments, including features formerly obtainable only as costly "specials".

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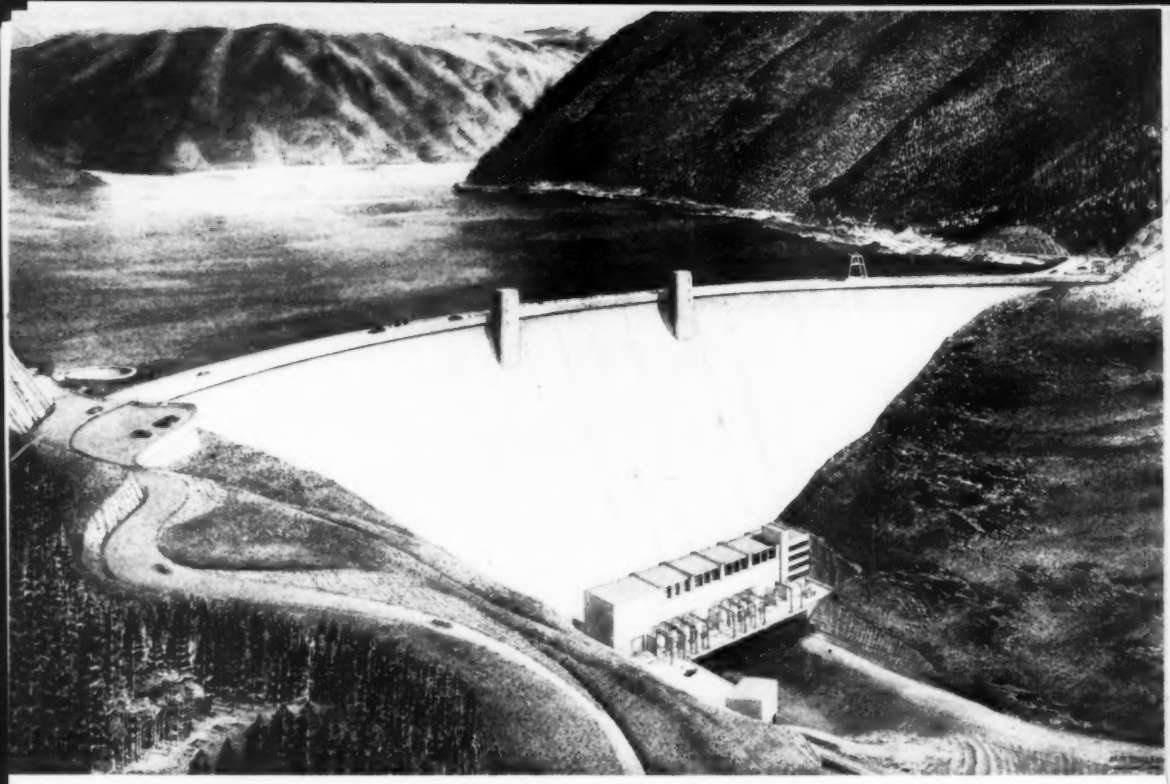


DAM AND POWER HOUSE. This dam, a concre.e arch 2115 ft long, will rise 520 ft from lowest point in its foundation, will contain 3,000,000 cu yd of concrete. Power house will have four 105,000-hp turbines driving 75,000-kw generators

Hungry Horse: 4th Largest Concrete Dam

► CONSTRUCTION OF HUNGRY HORSE DAM and power house, a U. S. Bureau of Reclamation project, is now well under way. The job calls for the construction of the fourth largest concrete dam in the world on the south fork of the Flathead River, 9 miles southeast of Columbia Falls, Mont.

Potential Benefits. Power production, flood control, water for irrigation of arid land, improved river regulation and increased power generation in the plants on the Columbia River system are among the potential benefits to be derived from this project. The dam, a concrete arch 2115 ft long, will rise 520 ft above the lowest point in its foundation, and will contain about 3,000,000 cu yd of concrete. It will be 39 ft thick at its crest and will have a 30-ft roadway and two sidewalks.

Raising the water level to elevation 3548 ft above sea level, the dam will form a reservoir of 3,500,000 acre-ft gross capacity, of which nearly 3,000,000 acre-ft will be active storage.

The structure designed to meet rapidly expanding power needs in the Pacific Northwest, will increase by 334,000 kw firm power capacity of existing downstream plants, at Kerr Dam and Thompson Falls, Mont., and at Grand Coulee, Rock Island and Bonneville dams on the Columbia River. Ultimately it will increase by 477,000 kw the firm capacity of other power plants to be installed downstream as part of the complete development of the vast Columbia River system.

World's Largest Dam. The dam will be the world's largest with a glory-hole spillway and tunnel. The spillway's top is shaped like an inverted morning glory and will be topped by a 64-ft diameter ring gate, 12 ft high. During dam construction the river will be diverted through a 36-ft unlined horseshoe-shaped tunnel, driven through rock for 1150 ft on one side of the river. Outlet of this tunnel will form the outlet of the spillway tunnel, which will be of circular section varying from 34.79 ft in diameter at the top to 24.5 ft at its smallest cross section.

In addition to the spillway the dam will have two 96-in. reservoir outlets, controlled by hollow-jet valves. These will be used to control water discharge from the reservoir when its elevation is below the spillway crest and will supplement power-house discharge.

Power House. Spanning the river at the toe of dam, the power house will have four units. Each will have a 105,000-hp vertical-shaft francis turbine directly coupled to a 75,000-kw 6900-v generator. Turbines are designed for 400-ft head, but this will vary from 485- to 260-ft.

Other three largest concrete dams are: Hoover, Colorado River in Ariz. and Nev., 730 ft high, 1244 long at crest, contains 3,250,000 cu yd of concrete; Grand Coulee, Columbia River, Wash., 550 ft high, 4200 ft long, contains 10,500,000 cu yd of concrete; Shasta Dam, Sacramento River, Calif., 560 ft high, 3500 ft long, contains 5,400,000 cu yd of concrete.

"Give us the tools..."

YOUR ONLY CHANCE of Getting Ahead

Where is the "brave new world" so glowingly promised us by the politicians during and after the war? We were told then that postwar America would live 50% better than it had before. Why has that promise faded out? Why are men today discouraged and frustrated?

We have not yet made good 1944's promises because the *American worker turns out no more in an hour now than he did in 1941.* We are getting more total production in our country – but only because we have more people working. Not because each one of us is producing more. American industry's ability to turn out more and more goods – with less of each worker's time and effort – has been stymied for eight long years.

Progress has been blocked because in some cases workers have not been willing to work as hard as they did before the war. In other cases unions restrict the use of labor-saving machines and methods. In some places obsolete building codes and ordinances prevent advances. In still other cases progress has been blocked by collusive practices between unions and manufacturers or operators.

But the biggest block to progress is the fact that our industry in the United States has been unable to provide our workers with all the new tools and equipment that they need.

Increasing productivity – that is, each one of us turning out more in each hour of work – is the key to higher living standards. Productivity depends directly upon the kind of tools workers use. His tools, more than anything else, determine how much a worker can turn out; and what his paycheck will buy depends in large part on what he turns out – not on how long or how hard he works.

Look what happened in our country in the forty years from 1900 to 1940. Productivity of the United States *more than doubled.* It doubled because:

Business investment in capital equipment gave workers new tools – tools that had three and one-half times as much power –

So – Americans' living standard rose almost 50% while the average work week was dropping from 61 to 43 hours.

Industry did continue to raise its output per man hour, even in the depressed 1930's. But it did it because, with unemployment widespread, companies used only their most efficient equipment. *Actually the great depression saw industry fall far behind in the job of providing workers with new tools.*

Then came World War II. Few new tools for peacetime industry were produced. *As a result of depression and war, the U.S. fell behind in needed investment in new industrial facilities by more than $100 billion.*

Since the war business has spent almost $60 billion for new plants and equipment –

But the greater part of that money went to *expand* production to take care of the needs of our bigger population, and to *replace* plants and equipment that were worn out and ready to be junked at the end of the war.

continued on next page

Only a small fraction of the $60 billion went to *modernize equipment* – the equipment that increases efficiency and improves productivity of the individual worker.

Right now industry is desperately trying to do the job of increasing efficiency of machines so that each worker can turn out more.

McGraw-Hill's national survey of Business' Needs for New Plants and Equipment shows that manufacturers plan right now to spend in the 5 years ahead three-quarters of their capital funds to replace and modernize facilities. The biggest part of the more than $55 billion industry plans to spend on its plants and equipment will go directly to improve efficiency of the individual.

If industry can carry through its plans – and expand them as it would like to and as it must do – the U. S. can catch up on its depression-war-time lag in progress within a few short years.

If American industry is allowed to earn the money to buy the equipment, it can raise the American standard of living 50% in our generation – in the next 25 years. No other nation can promise its people that much – and deliver on the promise.

But the promise can only be fulfilled by American industry. Wherever you turn, industry has dramatic new ways of doing things. Using oxygen by the ton, steel makers are increasing production from blast furnaces by 20%. New high-speed machine tools are doing three times the work of 1940 tools. A new coal-mining machine will multiply a miner's daily output 10 times. Diesel locomotives do the work of three steam locomotives on many jobs.

New products – and larger production of standard products – are already making their impact on American life. Two million Americans will get new television sets this year. Automatic washing machines, electric dishwashers, and home freezers are easing the daily tasks of thousands of housewives. Millions of homes that did not have them before the war now have telephones, automatic heat and refrigerators. Frozen foods, nylon clothing – these and many other things coming along now – will shape **the *real*** new world for Americans.

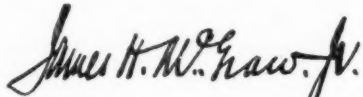
But industry can provide them only if it can keep on investing at least $15 billion a year now – and more in future years – in new plants and equipment.

Today Washington is taking a course which, if pursued, will make that investment by industry impossible. Government spending now strains our resources to the limit, and more multi-billion dollar spending proposals are being piled on. *But government spending cannot improve American living standards.* It never has, and it never will. Increasing government spending *now* will only block progress, because the government proposes to pay for its plans by taxing away the profits industry is using, and must continue to use, to improve and expand its plants and equipment – our only hope for greater worker productivity and higher living standards.

Better living can only be paid for with more production. And we can only get more production by increasing productivity – by each one of us producing more for each hour of work.

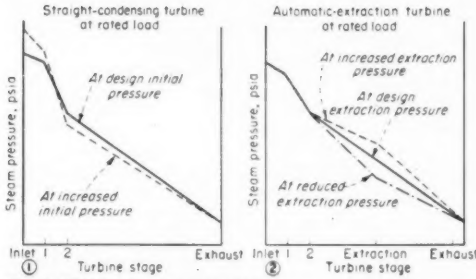
The first thing is to get the production – in peace and in war – for better living – for security. Industry is planning to provide it – and is using $13 billion of its profits this year to improve and expand its facilities.

The only sensible, the only safe national policy is to make it possible for American industry to do its job – not to terrorize private industry with proposals of ruinous taxation and paralyzing controls and threats of nationalization. For American industry is not a thing apart from the American people any more than is government. American industry is the lifeblood of the American people and whatever makes industry do its work better contributes more to the common welfare than a bureaucratic government can ever hope to do.



President, McGraw-Hill Publishing Company, Inc.

By E W BURSTADT and R O BUTCHER, *Turbine Division, General Electric Co*



STEAM-PRESSURE DISTRIBUTION through turbine stages is affected by change in initial and extraction steam pressures

Can We Operate Turbines Beyond Contract Conditions?

Turbine Specialist
District Office

Dear Mr Specialist,

In looking over the contract specifications for our new turbine-generator set, I noticed that allowable variations are given for initial steam pressure and temperature. These seem to be liberal enough to meet most emergencies, but what would happen if a turbine were called on to operate at steam conditions beyond those allowed in the specifications? How would performance be affected, and would there be any serious damage to the turbine?

Please give me your comments on the effect of both increases and decreases in pressure and temperature, since decreases are just as likely and might be just as serious.

Very truly yours,
ENGINEER

Dear Mr Engineer,

The allowable variation in steam conditions as given in your contract is taken into consideration in the turbine design. They are specified for the protection of both the user and the turbine manufacturer.

When a turbine operates at initial steam conditions above those for which it is designed the effects are more serious than when operating below them. Let's consider in more detail the possible changes in pressure and temperature and their effect on materials and turbine performance.

Straight Condensing and Noncondensing Units. An *increase in initial pressure* will increase steam flow through the turbine for a given opening of the governing valves. It will also increase the available energy per pound of steam. The turbine capacity will increase, but governor regulation will be narrower since the valves will not open as wide for a given output, or travel as far for a change in output. With this narrower regulation the turbine may have a tendency to "hunt" and disturb system frequency.

At increased initial pressure, first stage carries a greater percentage of load since pressure drop across it will be greater, Fig. 1. This may cause overloading of buckets as well as overstressing of casing walls and diaphragms.

A *decrease in initial pressure* will, conversely, give broader governor regulation and will reduce the capacity of the turbine. Valve sizes and nozzle areas will be too small to pass the increased flow needed for maximum output. For this condition there is usually no operating hazard.

An *increased initial temperature* within the allowable limits as governed by the material of the parts will have little immediate effect except for a slight improvement in steam rate. Rate of material creep, however, increases rapidly as the temperature rises and, for excessive rise, may eventually result in reduced life or excessively high maintenance to keep the unit in service.

A *decrease in initial temperature* will raise the steam rate slightly. The number of stages in the wet-steam region and the amount of moisture in each stage will increase. Hence, erosion of turbine parts in contact with wet steam will be accelerated.

Change in backpressure on a condensing turbine has little effect except on output, if the change is small. Exhaust temperatures and casing stresses usually limit operation of a condensing turbine at atmospheric pressure or higher. This is particularly true for ratings above 5000 kw. On larger turbines the manufacturer should be consulted before raising backpressure above contract specifications. When such operation occurs under emergency conditions, the relief valve or low-vacuum tripping device and its accompanying relief diaphragm should protect parts from damage.

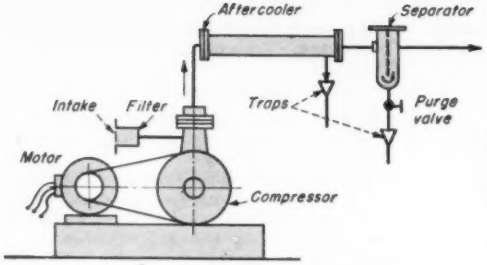
On noncondensing turbines, increase or decrease of backpressure affects output. Any change is limited by temperatures or stresses in exhaust casing and last-stage diaphragm and buckets. Always consult the manufacturer before decreasing backpressure on a noncondensing machine.

Automatic Extraction Turbines. Effect of pressure and temperature changes on the materials and performance of an automatic-extraction turbine will be the same as described above. There is, however, one additional difficulty that does not apply to straight condensing or noncondensing turbines.

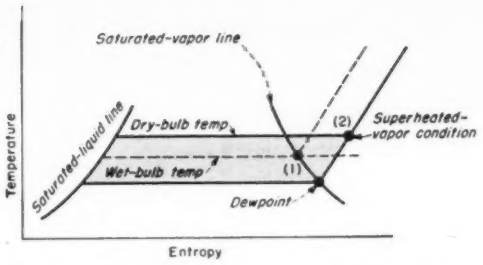
With automatic-extraction turbines any considerable change in initial steam conditions, extraction pressure or exhaust pressure without readjustment of the governing mechanism means that the energy distribution across each section of the turbine does not agree with the original setting, Fig. 2. Changes in load or extraction demands will be incorrectly compensated for and poorly controlled operation will result. This can be especially troublesome if the unit runs in parallel with other units, either electrically or through the extraction system, or both.

Rapid changes in operating steam conditions do not permit all turbine parts to reach a state of equilibrium at the same time. This causes warping and rubbing. On the other hand, precision-built turbines are surprisingly rugged and often stand considerable abuse under emergencies without excessive deterioration. If you save your extremes of operation for infrequent, abnormal conditions, you should have every expectancy of years of trouble-free operation.

Sincerely yours,
TURBINE SPECIALIST



A good aftercooler and separator fitted with traps will remove all excess moisture from a compressed-air system



2 At 100% saturation all horizontal lines coincide and dry-bulb, wet-bulb and dewpoint temperatures are the same (1)

Line Pressure Determines Compressed-Air Cooling

Pressure drop in distribution piping becomes an important factor when you have to consider the amount of water used in an aftercooler, says John D Constance, professional engineer

► MOISTURE CAN BE particularly troublesome in pipelines transmitting air under pressure. Consider instrument air lines carrying compressed air to points of automatic control. If water vapor is not removed from the air, this vapor will condense out somewhere along the line and cause erratic instrument operation. Should the pipeline be exposed to extreme cold the condensed vapor could freeze and plug up the line.

Properties of Air. By *psychrometric properties of air* we mean all the properties of air that are affected by the presence of water vapor mixed with the original dry air. From experience, we know there is no such thing as "bone-dry" air (air without the slightest trace of water vapor).

From now on we will use the word "air" to mean air, plus whatever water vapor is mixed with it. Before going further let's study (1) 100% saturated air (2) partly saturated air (3) dewpoint and (4) absolute humidity:

1. *100% saturated air.* When the vapor pressure of water vapor in air is equal to its saturation pressure corresponding to the temperature of the mixture, the air is said to be 100% saturated with moisture. In other words, the air is holding the maximum amount of moisture it can hold as a vapor at its particular temperature, and its relative humidity is then said to be 100%.

2. *Partly saturated air.* When the vapor pressure of the water vapor in air is less than the saturation pressure corresponding to the temperature of the mixture, the air is said to be partly saturated with moisture. In other words, the air is holding less than the maximum amount of moisture it can hold as a vapor at its particular temperature, and its relative humidity is less than 100%.

3. *Dewpoint.* Saturation temperature corresponding to the vapor pressure of the water vapor is called the dewpoint of the air. This is the lowest temperature to which the air can be cooled without condensation or "raining out" of some water vapor. If air is cooled a fraction of a degree below its dewpoint, some water vapor will condense.

4. *Absolute humidity* is expressed as the weight of moisture per pound of dry air. The values below were taken from a set of psychrometric tables.

Saturation temp, F	*Moisture per lb dry air, grains*
40	36.36
50	53.38
60	77.21
70	110.2
80	155.5

If air at 70 F contains 55.1 grains of moisture per lb, the relative humidity can be determined because we know if the air were saturated with water vapor at the same temperatue it would contain 110.2 grains per pound. Then

$$(55.1 \div 110.2) \times 100 = 50\%.$$

Practical Problem. To determine the proper temperature to which air must be cooled following compression so moisture will not condense in the line, consider air leaving a compressor and being cooled to such a temperature that it is saturated with water vapor or has 100% relative humidity. If this air is permitted to pass into a cooler distribution system, the pipeline will act as an aftercooler and more moisture will condense out.

Suppose the air is at a pressure of 150 psig, temperature of 150 F, and is saturated with water vapor. Using an atmospheric pressure of 14 psia find:

Part 1. To what temperature must air be cooled in an aftercooler at the compressor to prevent condensation in the distribution line at a remote point where the pressure is 100 psig and temperature has dropped to 50 F?.

Part 2. When cooled as calculated in Part 1, how many gallons of water will condense in the aftercooler per million cubic feet of dry air?

Solution. Air leaving the compressor has a relative humidity of 100%. Under these conditions the dewpoint is 150 F. Just as soon as the temperature drops a fraction of a degree below this, condensation will take place.

From the steam tables (saturation tables) vapor pressure of water at 150 F is found to be 3.716 psia. This pressure is exerted at this temperature by water even if other gases and vapors are present (Dalton's Law). Then the water vapor content of the air, expressed in cu ft per cu ft of "bone-dry" air may be determined by:

$$\frac{\text{saturation press of water}}{\text{total press} - \text{saturation press of water}}$$

or $\frac{3.716}{(150 + 14) - 3.716} = 0.0232$ cu ft of vapor per cu ft of dry air. This is the water-vapor content at the compressor discharge before aftercooling. All pressures are in absolute units.

At the remote point in the transmission line the maximum amount of water vapor that the air could contain may be calculated in the same way. Here the saturation temperature is 50 F; and from the steam tables the corresponding saturation pressure is 0.178 psia. Dewpoint at the remote point is also 50 F. Thus, if the air is cooled at the compressor to a temperature corresponding to this vapor content, condensation will not occur. Then the cu ft of vapor per cu ft of dry air is:

$$\frac{0.178}{(100 + 14) - 0.178} = 0.00156$$

Accordingly air leaving the compressor must be cooled to a temperature low enough so water vapor in excess of 0.00156 will condense in the aftercooler. We must now simulate pressure conditions at the compressor discharge and knowing the maximum water-vapor content we can calculate a saturation pressure, p, corresponding to the temperature to which the air must be cooled to prevent condensation in the pipeline. Knowing we can have only 0.00156 cu ft of vapor in the air let's assume negligible pressure drop in the aftercooler, and solve for p by transposing:

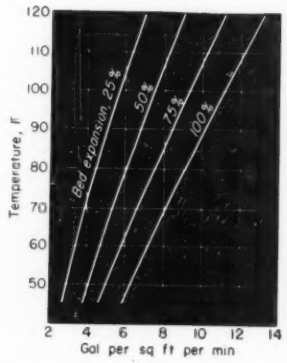
$$\frac{p}{(150 + 14) - p} = 0.00156 \text{ or}$$

$$P = 0.255 \text{ psia}$$

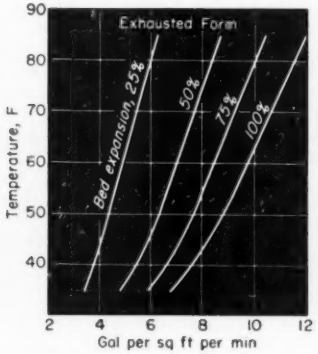
Then 0.255 psia is the saturation vapor pressure of water at the desired aftercooler temperature.

Referring to the steam tables we find that p corresponds to a temperature of about 60 F. This is the temperature to which the air must be cooled in the aftercooler. And the greater the pressure drop in the pipeline, the higher the temperature of the aftercooler can be.

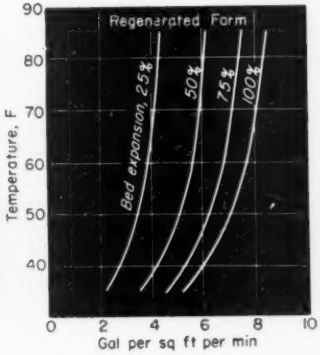
The solution to Part 2 may be used to size the trap and condensate-drain piping. Here the amount of water vapor removed from each cu ft of dry gas is $(0.0232 - 0.00156) = 0.02164$ cu ft. And $0.02164 \times 1{,}000{,}000 = 21{,}640$ cu ft of vapor per million cu ft of air. The density of water vapor at 14.7 psia and 60 F may be obtained because 18 lb occupies 379 cu ft. Then: $18/379 = 0.0475$ lb per cu ft, and since one gal of water weighs 8.34 lb, $21{,}640 \times 0.0475/8.34 = 123.2$ gal of water would condense out in the aftercooler from one million cu ft of air leaving the compressor.



1 Temperature of backwash water has considerable effect on bed expansion



2 Backwash characteristics of an anion resin (Amberlite) in its exhausted form



3 Lower density and smaller size of regenerated form means lower flow rate

How to Backwash Ion Exchangers

Effective backwashing cleans the resin grains by rubbing off dirt particles and flushing them away. These tips will help you keep your softener at peak capacity because they cover the bed-expansion factor

By J THOMPSON & F X McGARVEY, *The Resinous Products Div*

► RATE OF WATER UPFLOW through an ion-exchanger bed during backwashing should be such that bed expansion is at least 50%. With this expansion, the particles are scrubbed against each other, the bed is freed of contaminants, and resin particles are reclassified so the larger grains settle first to form the bottom of the bed. Expansion of the resin bed during backwash eliminates channeling or packing, which may cause reduction in operating efficiency.

Effect of Temperature. Temperature of the backwash water is one important factor governing bed expansion that is overlooked most frequently. Fig. 1

shows how bed expansion depends on temperature and flow rate for the cation exchanger, Amberlite IR-100. This chart illustrates the problem of the operator of an installation where a pump rated to deliver 5 gpm per sq ft at 60 F was used at 125 F. The resulting bed expansion of 18% was insufficient and could be raised to the desired 50% only by installing a new pump that could deliver the necessary 9 gpm per sq ft at the operating temperature.

Backwash characteristics of the anion exchanger, Amberlite IR-4B, are shown in Fig. 2. Because some applications may require backwashing of the resin bed before it is completely exhausted, Fig. 3 presents the data for the regenerated form of the resin. Because of the lower density and smaller size of this form, much lower flow rates are needed for the desired expansion.

Bumping. When the influent to the ion exchanger contains solids that coat the resin, and backwashing does not scrub the particles clean, bumping can be used to combat a progressive reduction in exchange capacity. This procedure consists of draining the exchange unit and allowing the backwash water to surge violently through the bed, thereby scrubbing the particles vigorously and freeing them of the coating. An increase in capacity of about 25% has been reported in one plant by operators who used this procedure in the middle and at the end of the exhaustion cycle.

With influents to the exchanger containing a high proportion of suspended solids, it is becoming rather common practice to use surface washers of the type employed in filter units. In one large Midwestern plant the increase in capacity resulting from the installation of surface washers in one exchange system has prompted their specification in all new equipment.

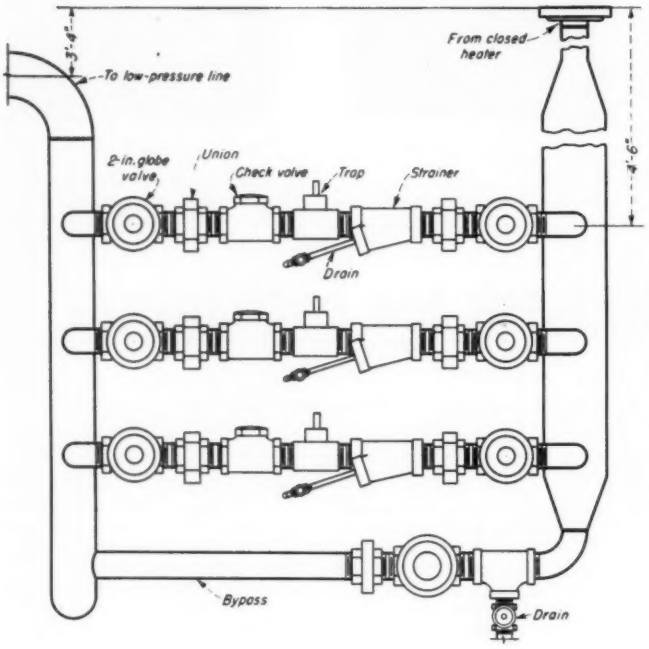
Microorganism Control. Contamination of exchange units by microorganisms presents a more difficult problem. Efficiency of Amberlite IR-100 in a Southern installation was markedly reduced by algae in the feedwater. The organism formed a crust on the surface of the resin bed, which resulted in excessively high head loss. Cracking of this crust led to channeling, premature break-through of ions, and a reduction in the operating cycle. Chlorination of the influent in concentrations of about 2 ppm effected lower head loss, longer cycles, and less frequent backwashing without altering the chemical or physical properties of the exchanger.

In another case, difficulty was encountered with iron-consuming microorganisms, probably introduced in the backwash water. Addition of 5 ppm of chlorine in the backwash water eliminated the objectionably high head loss caused by clogging the under-drain system.

Since organic-type exchangers absorb high concentrations of chlorine, it cannot be used to sterilize exchange beds in the bottling, pharmaceutical, beverage and food industries. This need, however, has been filled by the development, by a sterilizing reagent manufacturer, of a compound that gives every indication of killing bacteria without affecting the resin-type cation and anion exchangers.

Extracted from a paper presented at the Eighth Annual Water Conference of the Engineers Society of Western Penn.

Automatic Level Control for Condensate



► SKETCH SHOWS what we did to apply automatic level control to condensate in our closed heaters because the float-operated valves did not arrive before we started the plant. Although it was made for closed heaters, it is equally adaptable to other applications.

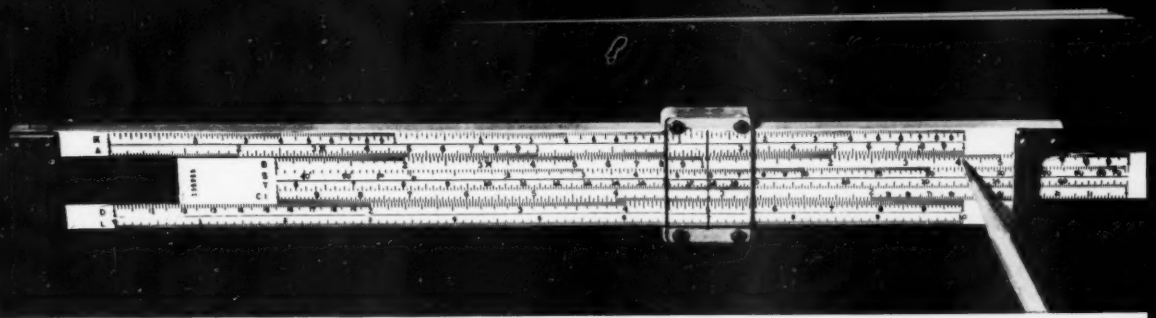
A very large trap would have been required if only one had been used, with the disadvantage of operation at different loads.

We arranged three impulse traps separated 12 in. vertically, as shown. Ahead of each trap is a strainer, while downstream is a check valve. Globe valves and unions are provided so a trap can be taken out for inspection while the others operate. A bypass is provided for emergency use and two headers connect all traps. The system worked until the float valves arrived.

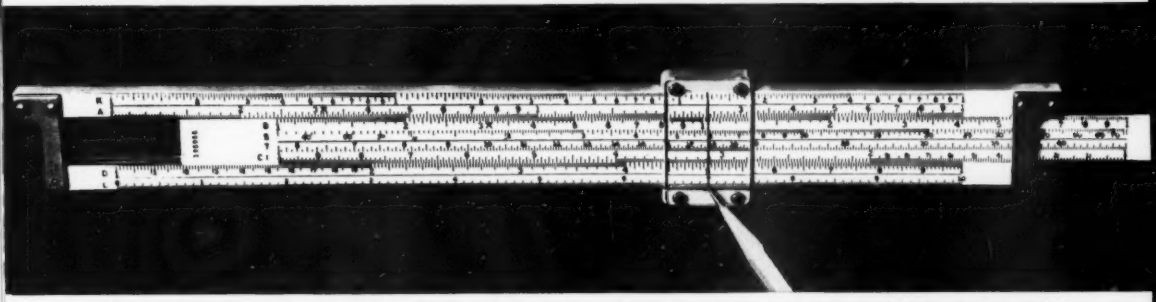
Note the way the three lines are connected to the headers through elbows. If they were connected straight, expansion due to difference in temperature between steam and condensate would cause the lines to leak.

SERGIO MARTINEZ JR *Havana, Cuba*

Effect of elbows on expansion depends on length of nipples between elbows and headers.—The Editors



1 First set wire diameter in mils on *C* scale and line it up with right-hand index on *D* scale. You'll find wire area in circular mils on the *B* scale opposite the *A* scale's right index. From this point on don't move the rule's center slide



2 Next step is finding the B and S gage number. Set indicator to 103 on *B* scale, then read log scale. Wire size is double this reading. Use 103 for wires No. 10 through 19, and 104 for larger wires. Use constant 102 for wires between 20 and 40

Slide Rule Pinch-Hits for Wire Gage

By **ALFRED ST. LAURENT**
Superintendent, Quebec Power Co

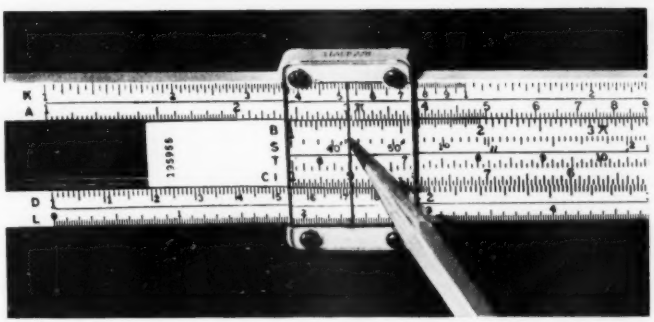
► EVEN THOUGH you have a wire table tucked away on the corner of your desk it's assuring to know how the slip stick can pinch-hit for it should the need arise. The ordinary slide rule will do the trick provided it has a log scale.

Where you know any one of the following, the remaining four quantities can be found—that is, wire diameter in mils, area in circular mils, wire weight in lb per 1000 ft, resistance in ohms per 1000 ft at 70 F, and the B and S gage number.

Typical Example. Take a wire whose diameter you know is 64 mils. Your first step in finding the remaining wire information is to set 64 on the *C* scale, opposite the *D* scale's right-hand index. Then look up to the *B* scale and you'll find 4100 lined up opposite the *A* scale's right-hand index. This 4100 is the wire's area in circular mils, Fig. 1. From here on, don't move the slider.

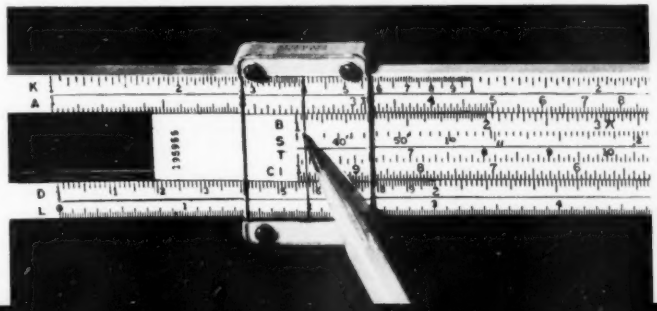
Your next step is to set the indicator's hairline to 103 on the *B* scale. Note that this lines up with 7 on the log scale, Fig. 2. Double this and you have the B and S gage No., which in this case

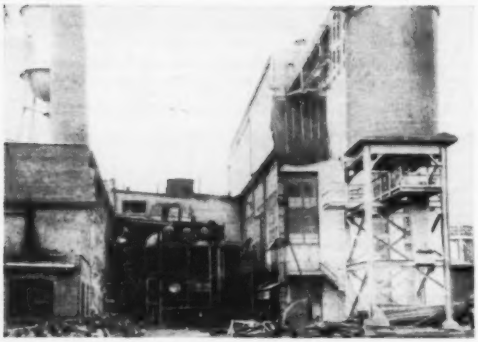
(*Continued on page* 164)



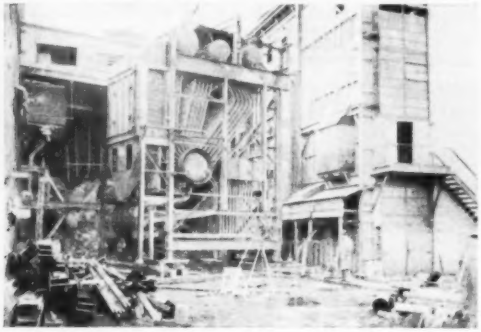
3 Without moving the slide, set indicator hairline to 302 on the *A* scale. Right underneath find 12.4 on the *B* scale. That's the wire weight in lb per 1000 ft

4 Last step is to go back to 103 on the *B* scale, and opposite it on the *A* scale find 2.52. This last figure is wire's resistance in ohms per 1000 ft at 70 F

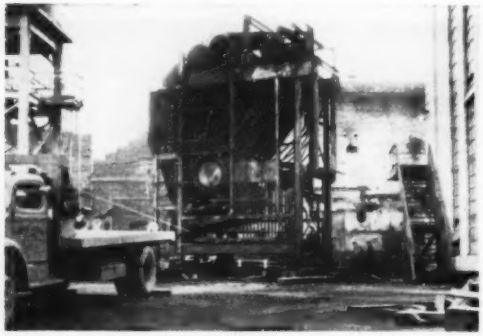




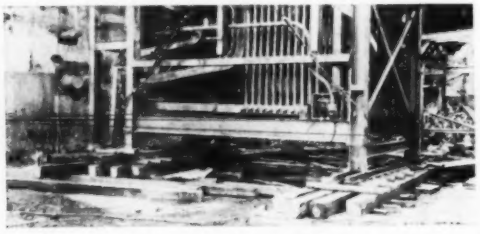
1 Old boiler-room building was demolished to make way for new turbine-room building. No. 4 is in its old location



2 No. 4 is just starting its journey on a trackway of wood timbers. Tunnel and ashpits in basement were shored up

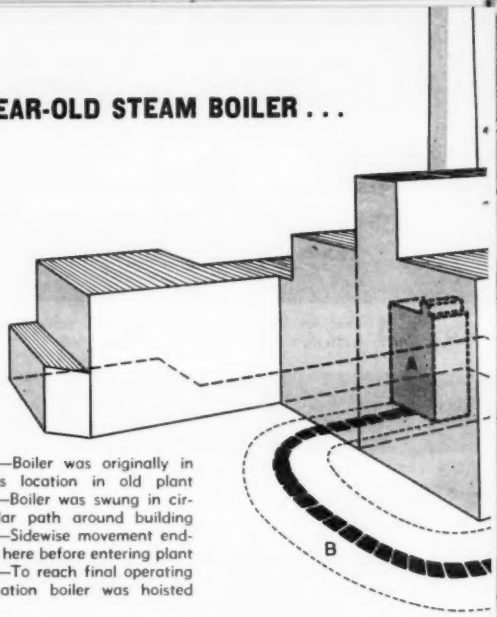


3 In moving around new power-plant building the boiler followed a circular path to get it in proper position finally



4 Boiler columns were braced by welding angle irons and beams between. Columns rode on skids of railroad rails

14-YEAR-OLD STEAM BOILER . . .



A—Boiler was originally in this location in old plant
B—Boiler was swung in circular path around building
C—Sidewise movement ended here before entering plant
D—To reach final operating location boiler was hoisted

New Plant Layout

A veteran boiler is fitted into a new plant to serve for the rest of its useful life. New steam generator will replace it when needed later

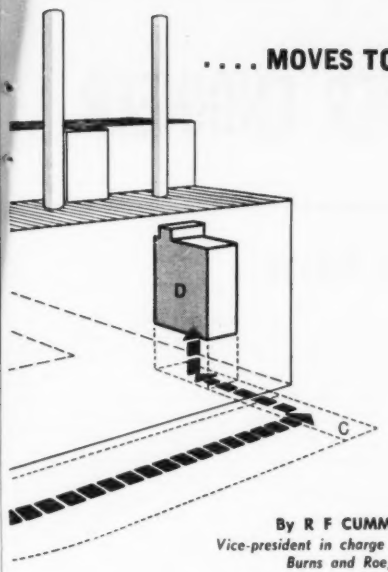
► No. 4 BOILER of the Colgate-Palmolive-Peet Co plant at Jeffersonville, Ind., was originally installed in 1934. In 1946, plans were laid to modernize the steam and electric plant. After reviewing the condition of the boilers it was decided to retain No. 4 for the remainder of its efficient life. This involved moving it to the new boiler room from the old one, which was demolished to make way for the new turbine room. The present plant consists of two new 65,000-lb-per-hr steam generators, No. 4 and No. 7, which was not moved. Provisions have been made, however, to replace the old boiler with a third new 65,000-lb-per-hr unit in the future when operating conditions warrant.

Coal chutes and dust collector now serving No. 4 in its new location are ample for the larger, future-replacement boiler. Only a minimum of rebuilding will be involved.

The Problem. This rearrangement required moving No. 4, a Combustion-Engineering-Co 4-drum bent-tube boiler, a distance of about 240 ft and around three right-angle turns, as shown in the diagram above. In addition, the boiler had to be rotated through 180 deg and raised about 15 ft above ground level so it could be operated from the same floor as the two new boilers.

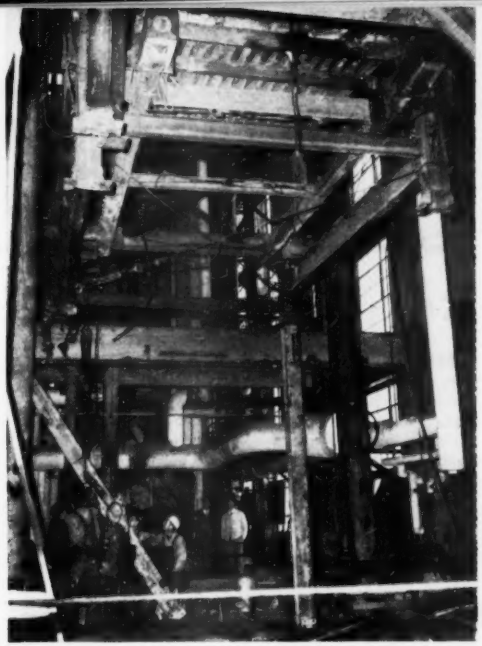
A thorough inspection was made of the boiler, which had been in continuous service since 1934. Several tubes in critical locations were removed, coupons made and tested. All were in excellent condition. The economizer tubes, however, had to be replaced.

The exterior brick walls of the boiler had several failure cracks. They were torn down and then replaced when the



By R F CUMMINGS
Vice-president in charge of engineering
Burns and Roe, Inc

Uses Old Boiler



5 After hoisting boiler to final position, supporting columns were placed underneath the four steam-boiler main supports

boiler was in its new location. Baffles and bridgewall being in good condition were left intact. Moving did not damage these boiler parts.

All valves, fittings, piping, castings, manholes and the like were stripped off the boiler and match-marked for easy replacement. The stoker was also dismantled and match-marked. Several parts such as dampers and wear plates were found damaged or worn out and were subsequently replaced.

Moving the Boiler. Two 18-in. I-beams connecting front and rear columns were welded in place, about 24 in. above the boiler column bases. These were used in raising the boiler from its original foundation with hydraulic jacks. Angle-iron cross bracing was welded between the two front columns, and necessary spreader beams installed to make the front rigid. Cable cross braces were used on each side of the boiler. Waterwall headers and bridgewall were supported by bracing with heavy angle iron.

Four 30-ton hydraulic jacks raised the boiler about 30 in. Heavy padded tracks of 8x8-in. and 6x10-in. timbers were laid and leveled with aid of a transit. Four-in. steel-tube rollers with ½-in. wall thickness were then placed on the timber track and two 5-in. steel railroad rails were placed side by side under front and rear columns to form a skid riding the rollers.

One 5-ton truck with a 20-ton winch pulled the boiler over the route. Two parts of ½-in. wire rope from the winch transmitted all the moving power. The timber tracks were laid on about a 100-ft radius. This allowed the boiler to make the 180-deg turn around the end of the new boiler house and at the same time be properly oriented for moving into the new boiler room.

The boiler was periodically checked for plumb with a transit. Old ashpits, tunnels, one sewer and manhole over which the boiler had to pass were braced The boiler was moved, at ground level, in five working days.

Hoisting Preparations. While one crew of men moved the boiler, another crew were rigging to raise it 15 ft to its new operating level. Because of limited space around the site, raising was done by four 14x14-in. gin poles set approximately in line with the four boiler columns. These poles were 50 ft long and guyed to the building steel. The two rear poles were rigged with 3-and-4 sheave blocks, using eight parts each of ¾-in. cable.

The two front poles were rigged with 3-and-3 sheave blocks, using six parts each of ¾-in. cable. These poles were rigged lighter because they carried less weight. To have equal strain on all poles, equalizer blocks were rigged on the two front poles by using one length of cable in the two falls. Where ordinarily the becket lines would dead off on these falls, the one line was reeved through snatch blocks on the drum girders, and then each end through the main falls, out to the winch truck. Each main fall was lashed to the drum girders with 12 turns of ¾-in. cable sufficiently padded to prevent cutting the girder edges.

After all rigging was thoroughly checked, lead lines to the two front poles were snatch blocked out through the building and attached, one each to a double-drum winch truck. The same arrangement was used for the two rear poles. The hoisting trucks were each a 5-ton unit with a 20-ton capacity winch.

After tightening up all falls and making a test lift, all rigging was rechecked and made secure for the main lift. Army field telephones provided communications between members of the crew. The unit was hoisted the 15 ft in 75 minutes. Estimated weight of the boiler stripped was 50 tons. A sufficient factor of safety was used in the rigging in case of estimating error. Finally steel stub columns were placed under the boiler for supports.

After the boiler was in place a hydrostatic test at 600 psig was made. Several minor leaks were quickly rolled tight. It is not known whether these had existed or were caused by the move. The Oberle-Jordre Co, Richmond, Ind., moved the boiler. Engineering and erection were done by Burns and Roe, Inc, New York City.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

15—Electronic Direct-Current Relays

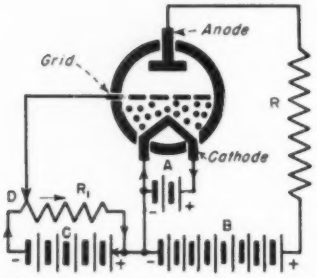
► MOST OF THE ELECTRON CIRCUITS we have considered use tubes for changing (rectifying) alternating into direct current. In the future, most of the electronic-equipment diagrams will include rectifier, control and amplifier circuits. There are many of the last two, some of them quite involved. So at this time it is well to study, in simplified form, some of these circuits, such as relays. Later, this will help us understand more readily the operation of more complicated equipment.

For rectification, we need only 2-element thermionic tubes, but to control and amplify we must use at least triodes (3-element tubes). In many applications, tetrodes (4-element) and pentodes (5-element tubes) are used.

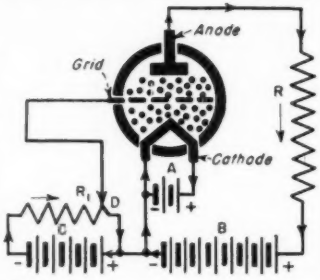
Three-Element Tubes. In operating a 3-element vacuum tube with constant cathode temperature, two factors can change the number of electrons reaching the anode: (1) anode volts, or voltage across the tube (2) voltage on the grid with respect to the cathode. Because the grid is relatively close to the cathode, its voltage is many times more effective in controlling a tube's output than anode volts. For example, assume 10 milliamperes (ma) pass through a given triode when 200 v are impressed on its anode and —5 v on its grid.

Assume that at 150 anode volts, current drops to 4 ma, but reducing the grid bias to —2.5 v, anode current increases again to 10 ma. In this case a change of —2.5 v bias on the grid is as effective in controlling the tube's output as 50 v on the anode. When anode volts' change is divided by change in grid volts we get $50 \div 2.5 = 20$. Ratio of these voltage changes is called the amplification factor, desig-

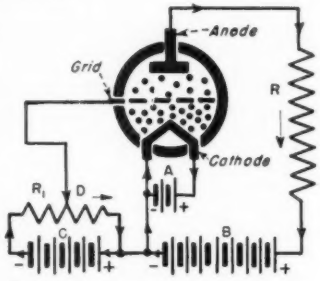
Relay Circuits Powered by Batteries



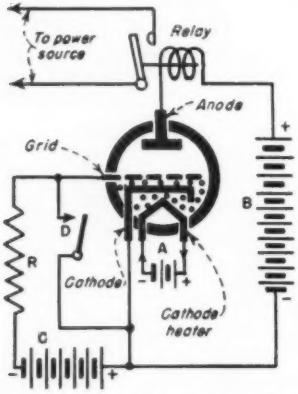
1 Simple connections regulate triode output by controlling grid voltage



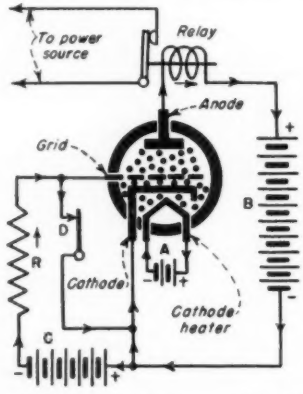
2 Moving contact *D* to right reduces grid voltage and the tube conducts



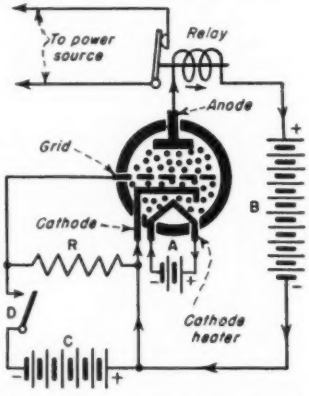
3 Moving contact *D* to center of resistor *R* reduces current flow in tube



4 When contact *D* is open, minus bias on grid prevents tube conducting



5 Closing contact *D* removes minus bias from grid, and the tube conducts



6 Connections arranged so the tube conducts when contact *D* is open

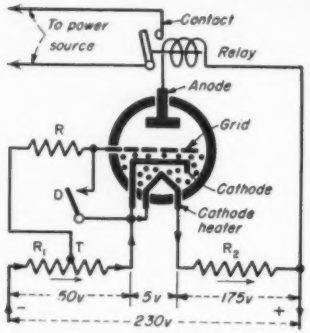
WHAT'S *a Boomerang* got to do with Ash Handling?

We all know that a boomerang is a weapon used by the Australian aborigines and that, when thrown, it strikes its target and then curves around, returning to its thrower. . . . A Recirculating Hydrojet operates in a very similar manner. The water used for hydrojetting and pumping of ashes is returned and re-used time after time for ash handling, only a very small amount of make-up being required to compensate for the water loss due to ash absorption. Absolutely none goes to sewer or waste, so there is no pollution of lake, stream or harbor. Our nearest representative will gladly give you the complete story. Write us.

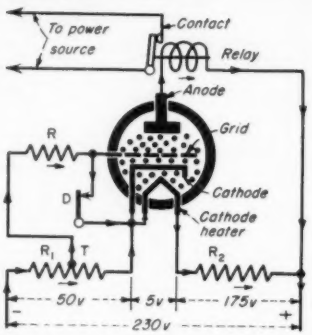
HYDROJET *Ash Handling*

ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. ***Offices & Representatives in Principal Cities***

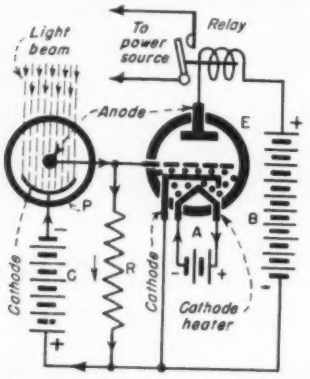
Resistors Replace Batteries



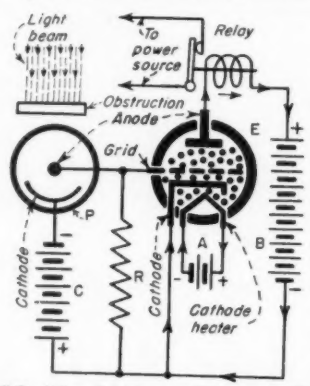
7 Resistors replace batteries, Fig. 6, so the relay can operate on 230 v



8 When contact *D* closes, it gives the grid and cathode the same potential



9 Phototube *P* replaces contact *D*, Fig. 6, to control minus bias on the grid



10 When light is cut off from tube *P* tube *E* can conduct and close relay

nated by the Greek letter μ (Mu), and is sometimes called the mu factor.

This factor indicates the number of times more effective the grid volts are than the anode volts in controlling tube output. Amplification factor of a tube depends on its grid construction, distance between grid and cathode and between cathode and anode. Some triodes have an amplification factor as high as 100, while others may have one as low as 3 or less.

Controlling Triode's Output. Fig. 1 shows simple connections to regulate a triode's output by controlling the voltage applied to the grid. This voltage is often called the grid bias. When minus, it is designated as a minus bias.

In the figure, the cathode is heated by a low-voltage battery *A*. Battery *B* provides the anode volts to cause current to flow through the tube and load resistance *R*. Battery *C* puts a minus bias (voltage) on the grid to control tube output.

A high resistance, connected across battery *C*, controls grid bias. Assume that battery *C* develops 10 v. When contact *D* is on the left-hand end of resistor R_1, full battery voltage is applied from the grid to the cathode. If the grid and cathode were in contact a current would flow through them from the — terminal of the battery back to its + terminal. But since the grid and cathode are separated, battery *C* voltage exists across the space between the two to make the grid minus, relative to the cathode.

The grid being minus acts like the minus plate of a capacitor. An excess of electrons collect on it that repels those released from the cathode by heating. If the minus bias on the grid is high enough it will accumulate sufficient electrons to repel all those released by the cathode and the tube cannot conduct.

Action of the Grid. Assume this to be the condition when 10 v of battery *C* are applied to the grid, Fig. 1. Since current flow through the tube is blocked, a full 200 v of battery *B* exist from cathode to anode.

If contact *D* is moved to the other end of resistor R_1, as in Fig. 2, grid bias becomes zero, because the grid and cathode both connect between batteries *B* and *C*. Now the tube conducts almost as if it did not have a grid. Assume that under these conditions 10 ma (0.01 amp) flow in the anode circuit from — of battery *B* to the cathode and anode, through resistor *R* and to the + battery terminal.

Volts' drop across a resistor equals its resistance in ohms times the current in amperes. Then, if *R* is a 10,000-ohm resistor, volts' drop across it equals $10{,}000 \times 0.01 = 100$ v. That is, if we connect a suitable voltmeter to the resistor's terminals it would read 100 v. The difference between this and battery *B* volts ($200 - 100 = 100$) exists across the tube.

Moving contact *D* to the center of resistor R_1 gives the grid a bias of —5 v. This is because the volts' drop across either half of resistor R_1 is 5 v. Then, if a suitable voltmeter is connected from *D* to either battery terminal it will read 5 v.

Current flows through resistor R_1 from the — to the + terminal of battery *C*, as in Fig. 3. It also tends to flow from contact *D* to the grid, the cathode and to + on the battery. But since current cannot flow in this circuit the grid has a bias of —5 v that opposes electron flow from cathode to anode.

Minus Bias on Grid. Assume that this minus bias reduces current flow through the tube and resistor *R* to 5 ma. Then the volts' drop across *R* is $10{,}000 \times 0.005 = 50$ v and voltage across the tube has increased to $200 - 50 = 150$ v. Here —5 v on the grid causes a 50-v change across the tube from cathode to anode.

Moving contact *D* to the left, as in Fig. 1, again increases the grid bias to —10 v, which we assume stopped current flow through the tube. Therefore, by moving contact *D* across resistor R_1 to change the grid bias, the tube's output can be adjusted from zero to maximum.

An adjustable resistor connected across a power source like R_1 is known as a potentiometer. Simply by moving contact *D* across the resistor any voltage can be had between zero and maximum of the power source. Other forms of potentiometers are also used and for different purposes.

Grid control is applied in many ways. In some circuits, the current is either turned on or off by the throttling action of the grid. In others, the current is gradually adjusted between limits.

On-Off Control. Fig. 4 shows an appli-

(*Continued on page* 150)

PENNSYLVANIA POWER Picks YARWAYS

FOR HIGH PRESSURE TRAPPING OF SOOT BLOWER PIPING

Add the name of Pennsylvania Power Company to the list of utilities using Yarway Integral Strainer Impulse Steam Traps for high pressure service.

On this installation at the modern Newcastle Plant Yarway traps are doing a good job . . . as they are in hundreds of high pressure plants including some of the hottest steam lines in the country. Yarway Super Pressure Traps meet all requirements on pressures up to 1500 psi. They have ample capacity when system is being "warmed up" . . . yet will handle relatively small amounts of high temperature condensate without losing prime. In presence of dry or superheated steam the trap valve closes.

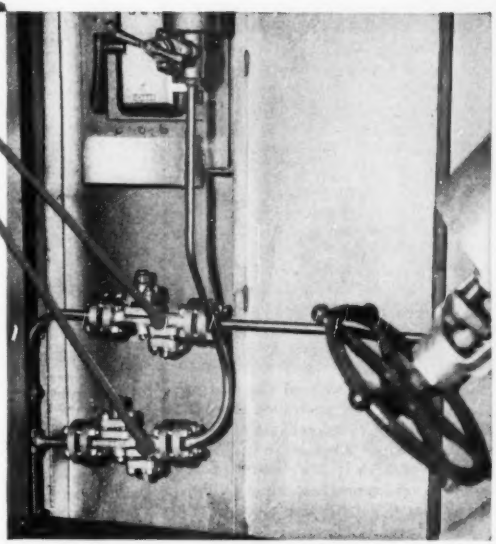
Small size simplifies installation. No special supports needed. Integral strainer feature protects against scale and rust, makes maintenance easier.

Yarway Integral Strainer Traps have the same simplicity of operation as standard Yarways—only one moving part, a small stainless steel, heat-treated valve.

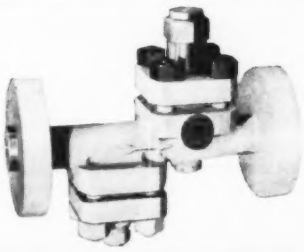
Over 600,000 Yarway Impulse Steam Traps have been bought in only 12 years.

Write for Yarway Steam Trap Bulletin T-1739.

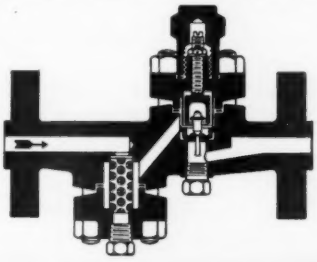
YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.



Yarway Super-Pressure Integral Strainer Impulse Steam Traps installed on soot blower drain lines at Newcastle Plant.



The Yarway Super-Pressure Integral Strainer Impulse Trap. Trap valve seats on solid stellite insert in welded-in stainless steel seat ring.



YARWAY IMPULSE STEAM TRAP

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

SIMPLE PIPE COILS PRODUCE HOT WATER FROM WASTE HEAT

A MANUFACTURING PLANT that burned considerable waste in an incinerator was faced with a rising demand for hot water. Enough waste was burned to produce the needed heat in a supplementary heater.

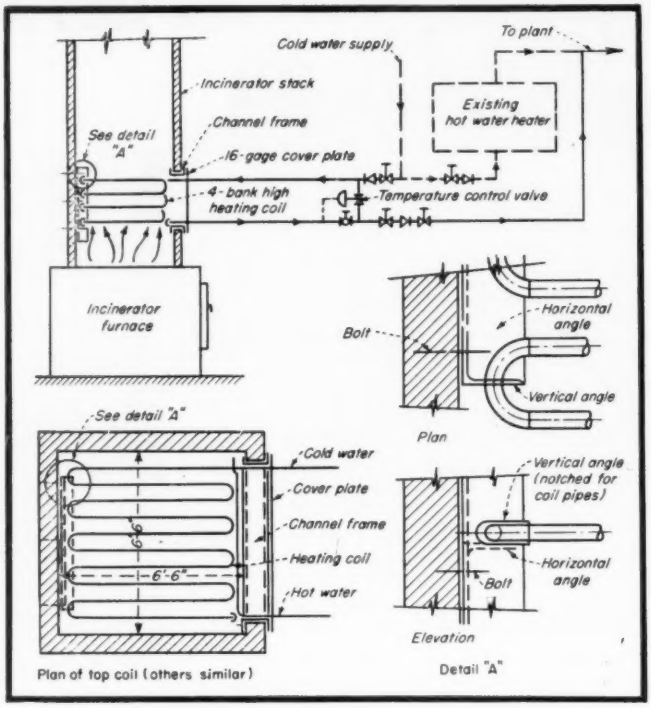
To use this energy a rectangular hole, 5 ft wide and 2 ft high, was cut in the brick chimney above the incinerator furnace. Channel irons welded at the corners framed the opening. A pipe coil inserted through the opening rests on angle irons bolted to the chimney wall opposite, see sketch.

The coil consists of four banks of 2-in. standard steel pipe, connected at ends through 180-deg fittings. All joints are welded and ground smooth. A 16-gage sheet-metal cover plate slips over the inlet and outlet ends. Screws fasten the cover to the channel frame.

Incinerator gas enters the coils with 600-F temperature. Average inlet-water temperature is 60 F. Discharge temperature varies with water flow; at 10 gpm it runs about 160 F. The coil connects in parallel with existing heater. A thermostatically controlled bypass valve between hot and cold water lines adjusts discharge temperature to 130 F.

Refuse burning is now controlled to supply a continuous heat input to the coil. Reduced water-heating costs justify the original $300 investment.

TYLER G HICKS *New York, N. Y.*



WHITE-PAINT MARKS SPEED UP MAINTENANCE JOBS

A FEW WHITE-PAINT MARKS properly applied can make the operating and maintenance job a lot easier. The long side of our rectangularly shaped engine room runs east and west. The three 1000-hp gas engines, four 45-mgd centrifugal pumps and three 10,000-cfm centrifugal blowers are each in line with their group.

Whenever the 15-ton traveling crane removes a particular engine, pump or compressor part for the first time we mark the main rails for the east-west direction opposite a reference mark on the hanging cab. With a long-handled paint brush the north-south direction marker is put on the carriage rail beam opposite the hook center. In our case, these marks hold for all units of any type of equipment, so distinguishing numbers need not be used.

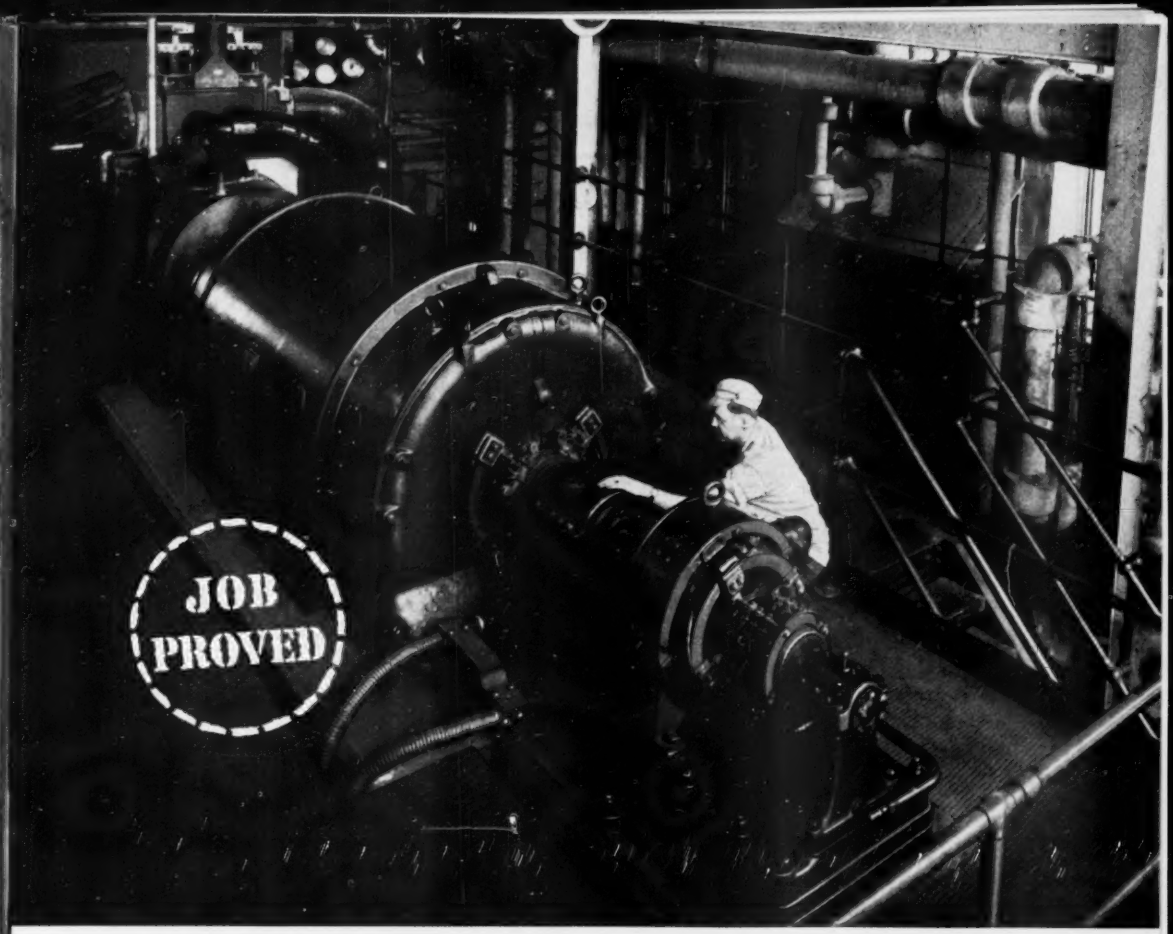
This marking saves a lot of time for any subsequent part handling. All the crane operator does is run the bridge and carriage to the marks and the hook will be at the exact spot needed on the equipment below.

In a plant I visited they used some white paint for an entirely different purpose. The operating engineer's desk was at one end of the engine room. Along both sides were whole rows of sleeve bearings. The ends of every shaft were painted white. This aroused my curiosity and I found the answer to be simple and ingenious.

By just glancing down each row of shaft ends from his vantage point at the desk, the engineer could tell if he had a hot bearing on his hands. The heated oil would show as a pronounced discoloration in the white paint within a very short time.

F J ARDOLINO *Brooklyn, N. Y.*

(*Continued on page* 124)



PROTECTED BY SUNVIS 916

Turbine Bearings and Journals Corrosion-Free Despite Summer Shutdowns — Oils Like New After 9,000 Hours

Three years ago, a paper mill overhauled a steam turbine. Thereafter, it was planned to operate this equipment on a 'round-the-clock schedule during the six winter months, and completely shut down in the summer. On the advice of a Sun Engineer, the mill charged the circulating system supplying turbine, generator journals, and governor with Sunvis 916. This oil was chosen because of its "Job Proved" ability to prevent rust and corrosion and to give troublefree lubrication for a long period of time.

The management's selection of Sunvis 916 proved to be sound. After 9,000 hours, a laboratory analysis of the oil showed it to be unchanged—comparable to a sample of new oil. Even more important, inspection showed no abnormal wear and no corrosion in bearings and journals, despite the summer-long shutdown.

The turbine has now operated 12,000 hours without oil-change, and it appears that none will be necessary in the foreseeable future.

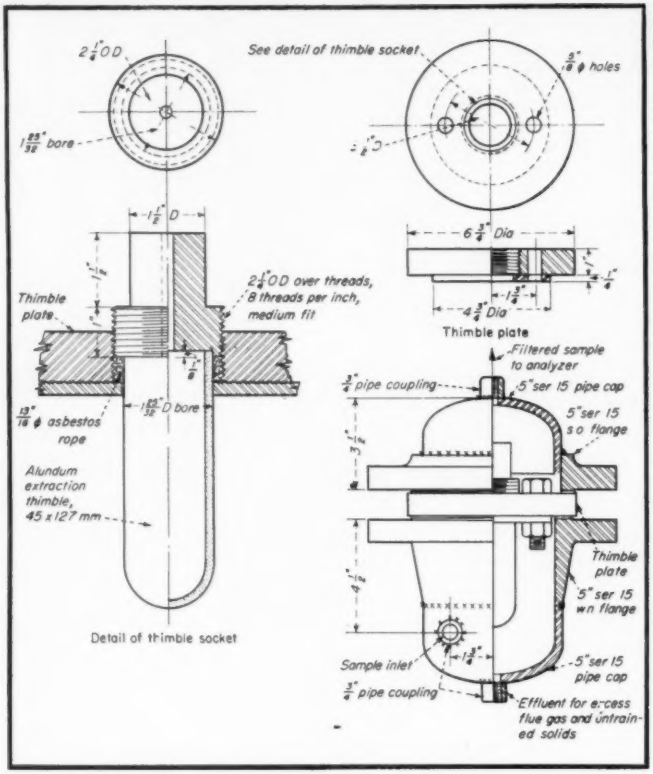
All oils in the Sunvis 900 series have a high viscosity index, are fortified against oxidation and sludging, and prevent rust and corrosion. Sunvis 900 Oils are the finest lubricants available for turbines, hydraulic systems, and similar applications. For a free, illustrated booklet on Sunvis 900 Oils, write Department P-7.

SUN OIL COMPANY • *Philadelphia 3, Pa.*
In Canada: Sun Oil Company, Ltd.
Toronto and Montreal

SUN PETROLEUM PRODUCTS
"JOB PROVED" IN EVERY INDUSTRY

SUNOCO

 (Continued from page 122)


2 1/4" O.D.
See detail of thimble socket
5/8" ϕ holes
1 25/32" bore
1 1/2" D
6 3/4" Dia
2 1/4" O.D over threads, 8 threads per inch, medium fit
Thimble plate
4 3/4" Dia
Thimble plate
Filtered sample to analyzer
3/4" pipe coupling
5" ser 15 pipe cap
5" ser 15 s.o. flange
13/16" ϕ asbestos rope
1 25/32" D bore
Alundum extraction thimble, 45 x 127 mm
Thimble plate
5" ser 15 w.n. flange
Detail of thimble socket
Sample inlet
5" ser 15 pipe cap
3/4" pipe coupling
Effluent for excess flue gas and entrained solids

Earthen Filter Prevents Gas Sample Contamination

WE CONTINUOUSLY ANALYZE the flue gas from the regenerator of our fluid catalytic cracking unit for its oxygen content. This gas has a high entrainment of catalyst fines and very high water-vapor content. This combination makes special sampling methods necessary to obtain reliable results.

Catalyst particles must be prevented from entering the analyzer. Condensation of the vapor in the sampling lines also proves very troublesome. The water mixed with the fines forms a mud that plugs the lines.

The separator shown in the sketch prepares the sample for entry into the analyzer. It combines an earthern filter, centrifugal action for mechanical separation, and provisions for cleaning the filter thimble. Velocities are made high enough to keep the gas temperature above the dew point.

Thimble sockets can be easily made without special equipment or tools. They are designed so a gas-tight joint between thimble and thimble plate can be made without excessive crushing action. Asbestos rope, 3/16-in. dia, acts as the sealing material between thimble and plate.

We believe this type of sample preparation can be used to advantage for pulverized-coal-fired installations.

C W BEARD *Galveston, Tex.*

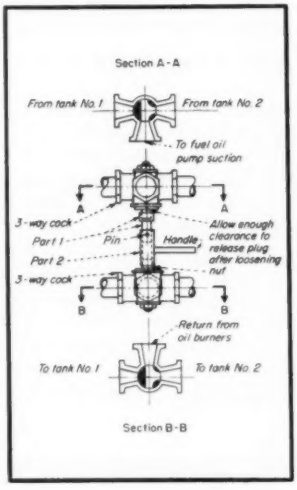
SIMULTANEOUS COCK OPERATION PREVENTS FLOODING OIL TANKS

MANY FUEL-OIL PIPING SYSTEMS use two or more oil tanks so it is possible to overlook changing over return lines in switching from one tank to another. This transfers oil from one tank to another, possibly causing flooding. Also, records of oil consumed are confused.

Suction and return cocks in oil lines, arranged as in sketch, prevent this. Two 3-way cocks are installed with square stems in line facing each other—one in suction, the other in return line.

Part 1 consists of a square socket made from a flat bar and welded to a square shank of solid cross section. The socket should be slightly greater in depth than the height of the square stem on the cock. The shank should be 2½ times as long as the height of cock stem and of same cross section.

Part 2 consists of a hollow-square extension piece made from flat plate to fit the shank of part 1 as well as the lower cock stem. A suitable handle from pipe or rod is welded to one side of part 2 to form a lever for rotating the cock plugs.



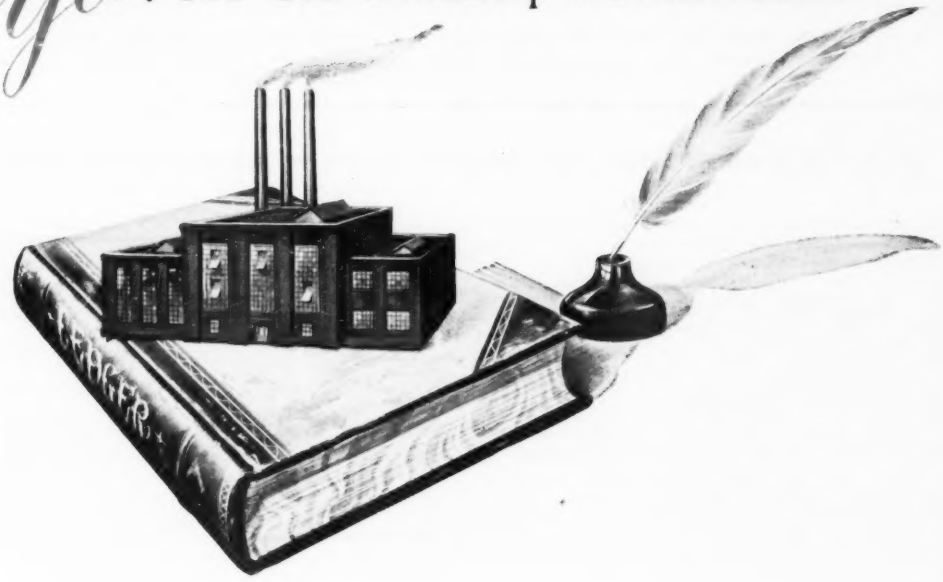
When preparing to operate the cocks, first slip part 1 into the upper end of part 2. Then slip the latter over the lower cock stem. Next pull up part 1 to cover the stem of the upper cock. Finally pin parts 1 and 2 together and the cocks are ready to turn simultaneously. This entire operation can be done in a few seconds.

The pin should be located so that the fit over the cock stems is loose enough to permit easy turning.

Turning the plugs 180 degrees changes both suction and return connections from one tank to the other. Center punch or chisel marks should be made on top of the plugs to locate the plug ports. Normally these marks are on the stem tops, which will be hidden by the handle.

M N KRAUS *Sunnyside, N. Y.*

Yes, You Can Bookkeep a Boiler Plant!



The economic advantage of a correct and complete water conditioning service in your boiler plant can be readily figured. It is a sum of savings effected through elimination of the many unnecessary shut-downs directly traceable to an inefficient water treatment.

Efficient water conditioning starts with the raw water supply and continues through the plant, taking in many problems. Trouble-free operation is a result of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical.

Our nationwide staff of engineers will welcome the opportunity of discussing with you this important subject of water conditioning . . . W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

PROBLEMS FROM THE PLANT

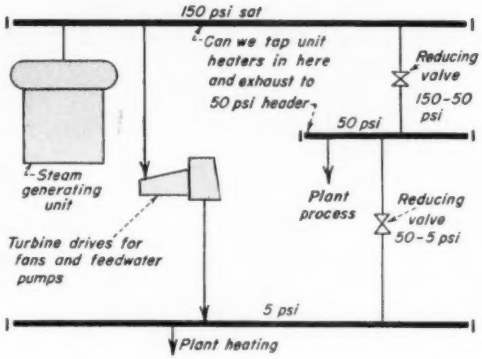
Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

IS IT PRACTICAL TO TAP UNIT HEATERS DIRECT TO HIGH-PRESSURE LINE?

OUR PLANT IS in the throes of an expansion program that includes adding a new building and heating system. We are set on using unit heaters in this building and are toying with the idea of piping the heaters direct to the high-pressure steam supply. We may then use the exhaust as supply for plant process.

Sketch to right shows rough layout of the steam supply system we will install. We will generate steam at 150 psi and deliver it to our boiler auxiliaries such as turbine-driven fans and feedwater pumps. From there we will run to a reducing valve to drop the steam pressure to 50 psi, then feed it to a header. In addition to the plant process tap we will come off the 50-psi header to another reducing valve, which drops the steam further to 5 psi.

We have heard much about the merits of using a high-pressure steam supply to unit heaters and applying the exhaust to process. Would it be wise to use 150-psi steam for our unit heaters and exhaust direct to the 50-psi header? We would like POWER readers to give us the benefit of their experience.—*JC*


150 psi sat
Can we tap unit heaters in here and exhaust to 50 psi header
Reducing valve 150-50 psi
50 psi
Steam generating unit
Plant process
Reducing valve 50-5 psi
Turbine drives for fans and feedwater pumps
5 psi
Plant heating

READERS' ANSWERS

Is Water-Pressure Rise In Condenser Significant?

(This question is from April issue with best answers from readers.)

We have been operating our condensing turbine for many years but it was only recently that we noticed an unusual condition. When the turbine is up to speed, pressure of the circulating water increases about 5 lb.

Sketch to right [*see sketch, p 134, April* POWER] *shows the general layout of condenser, circulating pump and spray pond for cooling condenser water. The condenser we own handles 14,000 lb of condensate per hr at 28-in. vacuum.*

About 1500 gpm of circulating water is used at 70 F. The condenser has 1250 sq ft of cooling surface and is designed for two passes of the cooling water. As usual, the turbine exhaust surrounds the cooling condenser tubes.

We run into many problems from time to time but this one has us stumped. We can't see how the turbine's running affects pressure of the circulating water.

We have been toying with the idea that expanding the condenser tubes might be the answer to our problem but we fail to see the logic of this move.

Perhaps POWER *readers have met up with a similar problem.*—BC

Is Trouble in Water Box?

CONDENSER IS LOWER than spray-pond floor; hence water flows through the condenser by gravity. Total head on circulating pump is algebraic sum of suction and discharge heads. Suction head is difference in head between level of spray pond and inlet to circulating pump, minus pressure loss through pipes, valves, fittings and condenser.

Sudden increase in pump-discharge pressure may be caused by increase in the positive head on pump suction. This, in turn, may result from a sudden reduction in pressure drop between spray pond and pump inlet. I believe *BC's* trouble is in the divided water box at left-hand end of the condenser. There is probably a leak that remains closed when the turbine is at rest. At turbine operating speed, vibration is set up, whose frequency is such that it causes the leak to open. This short circuits sufficient cooling water past the condenser to reduce the pressure drop that would result if this same water took its proper course through the condenser tubes.

BC should install three accurate pressure gages; one in condenser inlet, the second in condenser outlet, and third at the water box at right-hand end of condenser. In addition, test accuracy of pressure gage in circulating-pump discharge. Then take a series of readings of all four gages; the first with everything shut down, the second with circulating pump in operation, and others as turbine comes up to speed. If this series of readings shows a reduction in pressure between condenser inlet and outlet and a variation in pressure at the far end of the condenser, it will be to *BC's* interest to remove condenser water box, check for leaks.

H T LIVINGSTON *Los Angeles, Calif.*

Here Are Points to Check

TO MAINTAIN a constant partial vacuum, the quantity of circulating water must be increased when condenser load increases. For a condenser having ¾ in. No. 16 BWG tubes, 12 ft long, and an original tube velocity of 6 fps at operating load, a 10% load increase requires an increase in water velocity to about 7.1 fps. This results in a 40% increase in circulating-water friction head and a corresponding increase in discharge pressure.

If the 5-psi increase *BC* speaks of is in addition to the normal rise caused by change in load, he should check all

How to keep purchased power under control...

Ohio leather manufacturer keeps efficient balance between generated and purchased electric power with Worthington turbine-generator unit.

At the Ohio Leather Company, Girard, Ohio, purchased power is kept under direct control by means of a steam turbine generator unit which operates as a "reducing valve" to bring boiler pressure down to required levels for use in plant processes.

The turbine, a Worthington 750 KW straight non-condensing type, operates in parallel with the source of purchased power and has an automatic governor control responsive to both purchased or primary power and to plant demands for processing steam. This results in:

- limiting the *maximum* demands on purchased power to a predetermined top level, regardless of plant steam demands.
- limiting the minimum demands to a level which will prevent return flow of power to primary source when plant steam demands are high and power demands low.

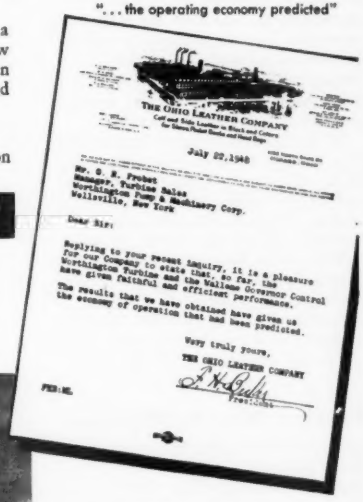
SAVE WITH WORTHINGTON

Savings to date on this installation are at a rate indicating 100% return on the initial investment in three years! For further details that prove *there's more worth in Worthington*, call your nearest Worthington District Office . . . or write direct to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.*

WORTHINGTON

STEAM TURBINES

"... the operating economy predicted"



THE OHIO LEATHER COMPANY

July 22, 1948

Mr. G. R. Probst
Manager, Turbine Sales
Worthington Pump & Machinery Corp.
Wellsville, New York

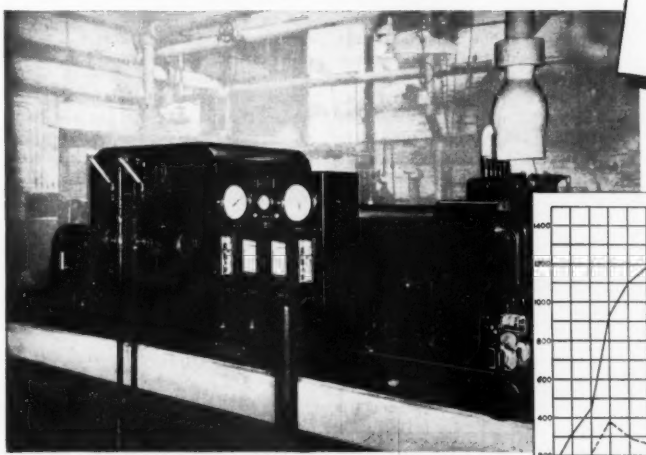
Dear Sir:

Replying to your recent inquiry, it is a pleasure for our Company to state that, so far, the Worthington Turbine and the Wallene Governor Control have given faithful and efficient performance.

The results that we have obtained have given us the economy of operation that had been predicted.

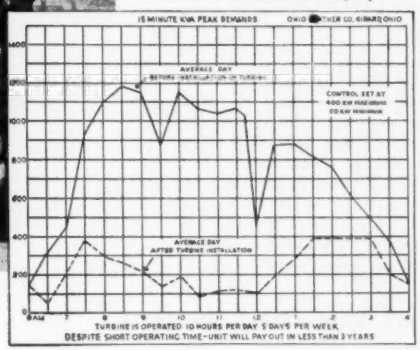
Very truly yours,
THE OHIO LEATHER COMPANY

FRH:RL



The Ohio Leather Company installation is a direct-connected turbine generator unit, 750 KW, 3600 rpm, 240 volt 3 phase 60 cycle. Steam conditions are 240 psi, 450° F, exhausting at 5 psig. Controls are by Wallene Engineering Co., Cleveland, Ohio.

"BEFORE AND AFTER"
... at the Ohio Leather Company

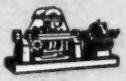

15 MINUTE KVA PEAK DEMANDS
OHIO LEATHER CO. GIRARD, OHIO
AVERAGE DAY
BEFORE INSTALLATION OF TURBINE
CONTROL SET AT
400 KW MAXIMUM
TO KW MINIMUM
AVERAGE DAY
AFTER TURBINE INSTALLATION
TURBINE IS OPERATED 10 HOURS PER DAY 5 DAYS PER WEEK
DESPITE SHORT OPERATING TIME-UNIT WILL PAY OUT IN LESS THAN 3 YEARS

T5-3

A GREAT TEAM IN STEAM

Feed Water Heaters

Multi-Stage Turbines



Boiler Feed Pumps

Turbine-Generator Sets

Single-Stage Turbines

Surface Condensers

possible faults that might cause enthalpy or quantity of turbine exhaust to increase. Some of these are internal rubbing, vibration, decreased efficiency, change in throttle steam pressure or superheat, tight packing or bearings, bent shaft, misalignment, worn blading, poor steam economy, corroded blading, overload on the turbine, or decrease in bleed steam rate.

RICK DENNING *New York, N. Y.*

Are Nozzles, Pipes Clean?

IF SKETCH is correct *BC* certainly has an unusual layout. With the condenser on suction side of circulating pump you can expect all kinds of trouble. Condenser apparently is in good condition, being able to maintain 22-in. vacuum with 70-F circulating water.

BC should inspect nozzle orifices and pipe leading to them. Clean them out well. All waters deposit a coating or scale on the piping, restricting the area of flow. This means greater pressure is needed to pass same volume of water.

With the turbine under load the circulating water will pick up 10-12 deg. increasing in volume. If the flow is restricted by dirty nozzles there is bound to be a pressure increase.

VINCENT STROJSA *Nova Scotia*

Problem May Be Electrical

PUMP-DISCHARGE PRESSURE RISE could result from increase in power input to pump or from throttling the discharge flow at any point downstream from the pressure gage.

As a practical matter it is hard to see how starting main turbine could cause throttling of pump discharge. But it might easily increase power input to pump. For instance, if pump is motor driven, supply voltage or frequency might rise because of electrical output of main turbine unit. If pump is turbine driven, change might be made from noncondensing to condensing operation, or a rise in boiler pressure might be scheduled at same time as starting of main turbine, etc.

ARTHUR HOLT *Atlantic City, N. J.*

Check Spray-Pond Nozzles

INCREASE in static suction or discharge heads or any increase in pipe friction might cause *BC*'s pressure rise. Yet on looking over all data given I believe the problem resolves down to scale in spray-pond nozzles.

Another point he should not overlook is the possible inaccuracy of the pressure gage.

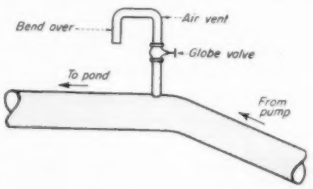
A VERSTOEP *Greene, N. Y.*

Vent Releases Trapped Air

BC's RISE IN circulating-water pressure results from one or more of the following causes:

1. Entrained air in circulating water. Temperature rise of water during turbine operation causes release of air. This air collects on discharge side of pump with resultant rise in pressure. Easiest way to remove air is by use of a vent, shown in sketch.

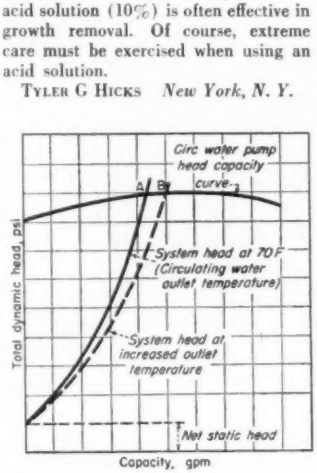
2. Clogged cooling-pond spray nozzles. Increased resistance to flow through nozzles would cause pressure rise on discharge side of circulating



pump during turbine operation when full pump capacity is being used. Inspection of nozzles and cleaning of clogged units would eliminate pressure rise.

3. Accumulated growths of organic matter in pump-discharge line. Reduction of discharge-line diameter would increase frictional resistance, necessitating a greater pressure at pump-discharge flange to produce required flow. Treatment with a weak hydrochloric acid solution (10%) is often effective in growth removal. Of course, extreme care must be exercised when using an acid solution.

TYLER G HICKS *New York, N. Y.*


Circ water pump head capacity curve
A
B
System head at 70 F (Circulating water outlet temperature)
System head at increased outlet temperature
Net static head
Total dynamic head, psi
Capacity, gpm

Might Be Typical of Pump

IT IS POSSIBLE to get an increase in circulating-water pressure with a pump having a "drooping" head curve, as in the above curve. This characteristic is often obtained with propeller or axial-flow impellers.

Operating the turbine at low speed and light load and with circulating-pump inlet-water temperature at 70 F, the system head curve *A* crosses the pump characteristic on the rising part of the curve. When the turbine reaches full speed, temperature of water will be nearly 90 F. Lower specific gravity, and reduced friction pressure drop in the condenser tubes, pump suction and discharge piping will move the system head curve to right at *B*. Total pump head increases and with decreased suction head it is possible to obtain an increase in pump pressure.

BC should check pump suction and discharge pressure as well as pumping water temperature the next time turbine is brought up to speed. Probably the mysterious pressure increase is due to pump's design characteristics.

IRA L MEYER *Philadelphia, Pa.*

Test Tubes For Leaks

PRESSURE RISE is caused by exhaust steam leaking through outlet-ends of upper tubes on last pass. Keep in mind that high exhaust pressure causes turbine-blade erosion.

BC should make a water-pressure test on steam side of condenser when turbine is shut down. This will tell if tubes are leaking. Some tubes may need rolling-in as *BC* mentions, while others with splits or holes should be replaced or plugged off. He will probably find the tubes with splits or holes are plugged at inlet-ends because of poor circulation. This would cause the high exhaust pressure to act through outlet-ends only.

I suggest turbine blading be thoroughly checked for erosion, and steam side of condenser checked for leakage. It's my belief that when these two faults have been corrected gage pressure will become normal.

ARTHUR BELTON *Montreal, Can.*

No Cause for Alarm

PRESSURE INCREASE while operating turbine stems from lowering of suction head on pump. This may be traced to thermosiphonic action that takes place as water temperature rises in outlet side of condenser. Pump efficiency will increase, resulting in a higher discharge pressure.

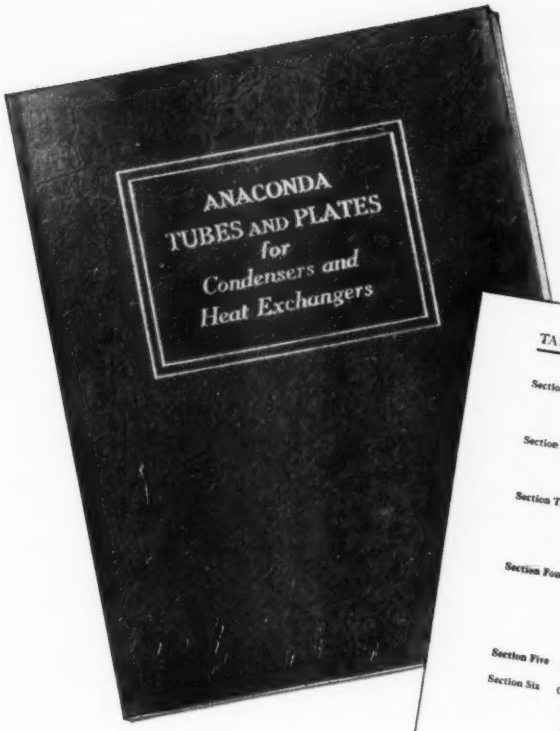
Incidentally, I believe the circulating pump is on the wrong side of the system. Outside of that I see no cause for corrective measures.

W V DUKE *Philadelphia, Pa.*

(Continued on page 156)

Here's a Book

that's full of things you want to know...



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TECHNICAL BRIEFS

ENGINEERING DEVELOPMENT HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

FUELS AND FIRING: What Can the Small Plant Do About Flyash? • Stoker Firing of Large Boilers, Past and Present • Cause and Prevention of Slag Deposits • Furnace Performance With Overflow Jets

ELECTRICAL PROPERTIES: Electrically Charged Dust in Rooms—Electrostatic Precipitators as Air Cleaners • Electrical Noise at the Sliding Contact—Noise-Making Voltages in Commutators

HYDRAULICS: Pumped Storage Installation • Soft-Rubber Bearings—Design and Application to Water Lubrication

Directions for ordering papers are given on page 132

FUELS AND FIRING

WHAT CAN THE SMALL PLANT DO ABOUT FLYASH? *by Carl E Miller, Battelle Memorial Institute.* Small boiler plants number in the thousands. They consume about 10% of the total coal produced in a year, somewhere near 50 million tons. Many of these plants serve hospitals, apartments, hotels close to residential areas, so the flyash problem they create represents a public nuisance more grievous than with larger plants in heavy industrial areas.

What can be done about the problem? Right at the moment the available data on small plants is negligible. But the increasing emphasis on reducing all kinds of air pollution from all sources means we must get about the job of (1) analyzing the small plant (2) developing practical answers to its problems.

The coal producers, as a group, have taken action. Bituminous Coal Research, Inc has studies under way at Battelle Memorial Institute to find better and lower cost methods of reducing flyash.

Small plants have three possible methods of reducing flyash: (1) changes in operating conditions (2) different or more modern firing equipment (3) installation of a flyash collector. Under today's smoke-ordinance regulations, these plants must meet certain dust-emission standards. Table I shows some typical ones.

This paper discusses usual firing methods in small plants and gives some data on flyash carryover for these methods. It then goes into the subject of flyash collectors available on the market. Table II lists price estimates for certain of these collectors. *MWP Paper. No number.*

STOKER FIRING OF LARGE BOILERS PAST AND FUTURE, *by J S Bennett and F C Messaros, American Engineering Co.* The authors begin by tracing the development of stoker-firing from as far back as the early underfeed retort stoker for high-capacity units, put in by Detroit Edison. This development includes curves on coal-burning rates, per ft of furnace width, and for pounds of steam generated per hr.

Then in the mid-Twenties pulverized-coal firing became a factor and permitted a sharp increase in amount of coal burned per ft of furnace width. Recently the spreader stoker has come into its own. With continuous ash-discharge designs it gives excellent efficiencies with a wide range of coals.

Their problems are now receiving the attention of top-flight design and operating engineers. Certain limits exist in furnace dimensions—roughly, about 18 ft for stoker length and the boiler-drum dimension for furnace width. To get around these restrictions the authors' company has set up a design where the firing is at right angles to the usual direction or across the furnace. This cross-firing could not be done with underfeed or chain-grate stokers because the gas composition varies so much from front to back.

But for spreaders this system will work. What's more, two or more stokers can be placed side by side to give enough heat release for generating steam from 300,000 to 500,000 lb per hr. Without exceeding demonstrated stoker practice a burning rate of over 2500 lb per ft of furnace width becomes practicable. Further, the double furnace construction enables shutting off one stoker during low-load operation and avoiding the tendency of spreaders to smoke at low loads. *ASME Paper. No number.*

CAUSE AND PREVENTION OF SLAG DEPOSITS, *by E F Walsh, Narragansett Electric Co.* During the past eight years boilers have been plagued more or less with objectionable deposits on superheater and economizer tubes. The deposits become more troublesome as time goes by, indicating a progressive growth toward slag formation.

A number of studies have been run, both here and abroad, to determine the reasons for these slag deposits. From available data, slag falls into two classes: (1) slags attributed to melted

I: Dust Limits Shown by Typical Smoke Ordinances

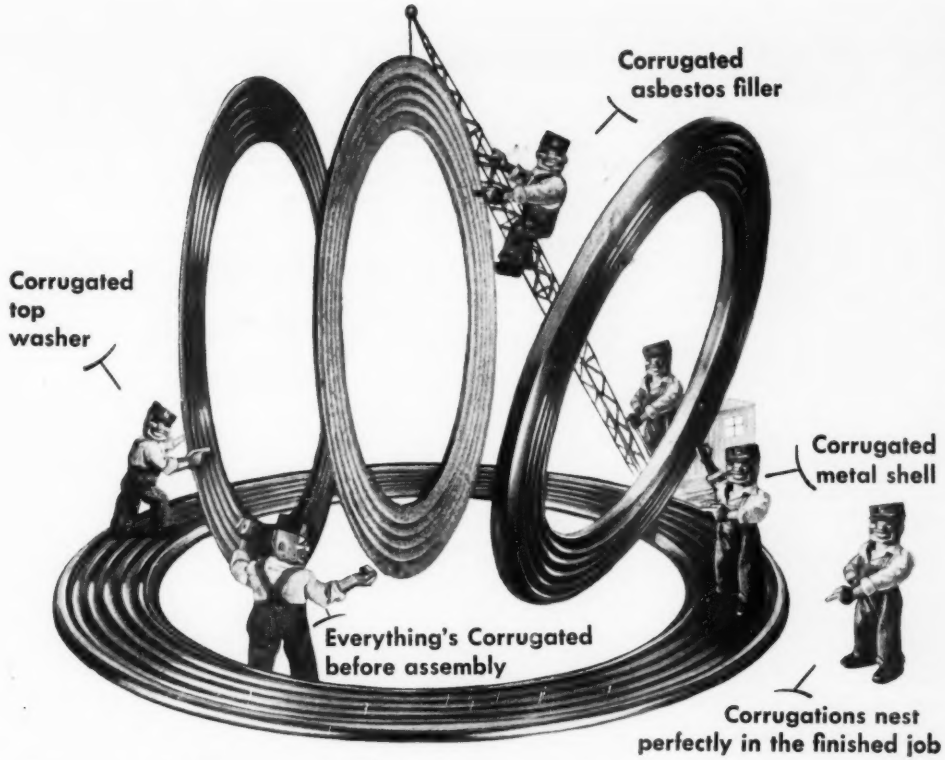
	Grains per cu ft		Lb per 1000 lb of flue gas
	300 F	500 F	
Baltimore	0.946	0.75*	2.49
Peoria, Illinois	0.505	0.40	1.32
Detroit	0.379	0.30	0.99
Cincinnati	0.324	0.257	0.85**

*Figures underlined are those specified in ordinance. **Suggested ASME ordinance.

II: Expected Cost of Small-Plant Dust Collectors

Developed rating, hp	Coal burned, lb/hr	Flue gas,* cfm at 500 F	Cost of collector unit: Collector only, cents/cfm	Including fan, cents/cfm	Installed, cents/cfm	Total cost, dollars
100	400	2730	25	37.5	75	2050
300	1200	8200	20	30	60	4920
650	2600	17,800	18	27	54	9600
1000	4000	27,300	15	22.5	45	12,300

*Based on 17.6 lb of flue gas per pound of coal and 23.5 cu ft per pound of flue gas corresponding to 12% CO_2 and 500-F stack temperature.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Corrugated top washer
Corrugated metal shell
Everything's Corrugated before assembly
Corrugations nest perfectly in the finished job

Greater Strength... More Resilience... Perfect Sealing!

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IN THE FABRICATION of the Goetze Style 926 metal-asbestos gasket shown here, each of the three units is corrugated *individually* to assure perfect "nesting" and matching in the assembled gasket.

This results in greater strength and resilience . . . and better sealability under high pressure. For these reasons, this gasket is recommended and widely used in chemical plants, power stations and oil refineries, especially where destructive elements are encountered.

Goetze custom-made gaskets—such as Style 926 above—pay off in the long run because of the meticulous care that is taken with every detail of construction . . . care and skill that is based on more than sixty years of meeting the specialized gasket requirements of industry.

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ash and confined mostly to primary and secondary furnaces where temperature is above the melting point of the ash. (2) slag deposits occurring in boiler sections where temperature is below the melting point and slag adhesion is due to the presence of various bonding agents.

Correction of these deposits seemed to need developing some means to prevent or retard formation of sulphur trioxide (SO_3). Operating experience showed the boilers to be immune from slagging for about the first year of service. That meant some element or compounds were in the original metal surface that prevented slag formation. Laboratory studies inclined toward lime-coating as the protecting surface.

So when a boiler came off the line all slag was removed and tube surfaces washed with alkaline water to neutralize all acid in the pores. A lime slurry was then applied to all surfaces with a commercial spray gun. No slag difficulties developed in that boiler for the next year. *ASME Paper No. 49-S-19.*

FURNACE PERFORMANCE WITH OVERFIRE JETS, *by W S Major, Bituminous Coal Research, Inc.* Thousands of commercial and industrial plants have installed modern overfire air jets for smoke abatement. For many years industry has used such jets. But only recently have their design and application been made the subject of engineering study. A report known as Technical Report VII, *Application of Overfire Jets to Prevent Smoke From Stationary Plants*, by BCR, has made this study available to the operating engineer.

This paper is a further development of the engineering approach to overfire jets. It is an answer to questions such as: Will overfire air adversely affect furnace CO_2? Will it reduce cinder carryover from the furnace? How does overfire air affect efficiency? Will overfire air reduce slagging on boiler and economizer surfaces?

There are a number of reported answers to these questions, most of which are referred to in the paper. For spreader stokers, the addition of overfire jets are held most beneficial. They break up any tendency of gas stratification over the fuel bed.

There are a few sources quoted for attributing overfire jets with reducing slagging and deposit formation because of the turbulence they set up.

In general, the following improvements result from overfire jets: (1) substantial reduction in smoke density (2) increases in boiler and furnace efficiency (3) reduction of both quantity and carbon content of cinder carry-over (4) shortening of flame and reduction of final temperatures when sufaces are of the same degree of cleanliness (5) reduction of soot and slag deposits. *ASME Paper No. 49-S-18.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources:

American Society of Mechanical Engineers' annual meeting, New York, Nov. 29-Dec. 3, 1948, and the spring meeting New London, Conn., May 2-5, 1949. Papers are identified by initials ASME and paper number. Available at ASME, 29 W 39th St, New York, N. Y.

American Institute of Electrical Engineers' winter meeting, New York, Jan 31-Feb 4, 1949. Papers are identified by initials AIEE and paper numbers. Available at AIEE, 33 W 39th St, New York 18, N. Y.

Midwest Power Conference, annual meeting, Chicago, Ill. April 18-20, 1949. Papers available through the Illinois Institute of Technology, 3300 S Federal St, Chicago 16, Ill.

ELECTRICITY

ELECTRICALLY CHARGED DUST IN ROOMS, *by G W Penney, Carnegie Institute of Technology, and G W Hewitt, Westinghouse Research Laboratory.* Well-designed installations of electrostatic precipitation have given satisfactory results in keeping buildings clean, but faulty design, installation or maintenance can cause low efficiency and serious trouble because of the electric charge on dust particles escaping from the precipitator. These particles normally carry a positive charge. The charged particles suspended in the air give rise to an electric potential within a room which is a maximum at some central point and decreases toward the wall and other grounded objects. Thus, a potential exists in such a direction as to drive the charged dust toward the wall. The full benefit of the air cleaner is not realized because charged dust near the walls, repelled by other charged dust suspended in the room air, travels more rapidly toward the wall than uncharged dust. This paper discusses the effects and the precautions that should be observed to reduce electrical deposition of dust on walls. These effects are particularly serious in large rooms, on columns, and on hanging light fixtures and similar areas exposed to high-voltage gradients.

Devices have been developed for neutralizing space charge but general experience in ordinary locations and with moderate size rooms has been that a unit of high efficiency properly installed will not give space-charge difficulties. But proper installation and maintenance are important. Special attention should be given to large rooms, such as auditoriums, and to especially dirty locations. *AIEE Paper No. 49-74.*

ELECTRICAL NOISE AT THE SLIDING CONTACT, *by V P Hessler, University of Illinois and M C Cotton, University of Kansas.* The ordinary sliding contact between a carbon or graphite brush riding on a copper surface has a layer of copper oxide with an overlayer of more or less translucent carbon between the copper and the brush. Because of the semi-conducting properties of copper oxide, resistance of such a contact varies as the ring slides under the brush. This variation in resistance, or the voltage arising from it, may be termed electrical noise. Usually it is of no consequence in power circuits, provided it does not cause ring burning or commutator sparks. This electrical noise may seriously interfere with a measurement or control circuit made through a sliding contact. To study these noises, three different sliding-ring materials were used in tests—electrolytic copper, electro-graphitic brush material, and a plated-silver ring. From these tests some of the conclusions arrived at are:

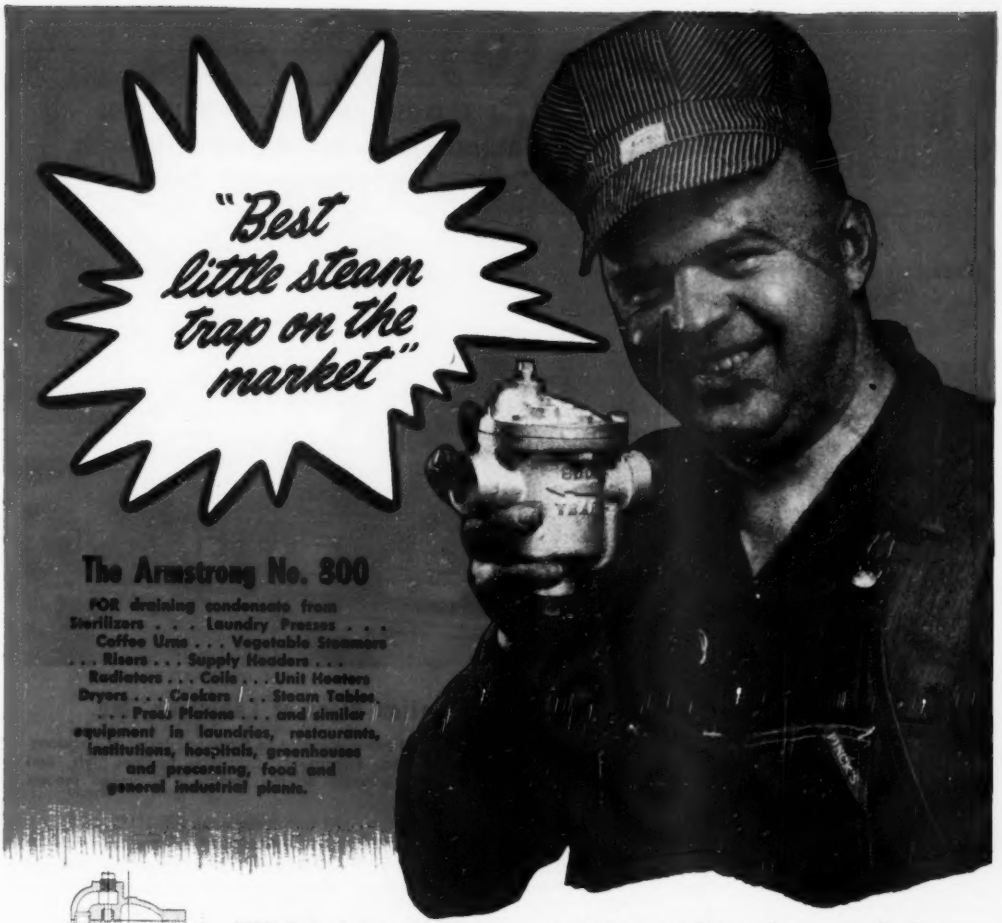
For high current values a natural-graphite brush operating as cathode on a copper ring showed considerable improvement over the electro-graphitic brush. However, at low current values the natural graphite was distinctly inferior to the electro-graphitic.

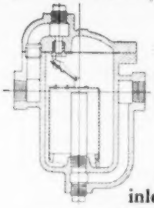
A carbon ring is quieter than a copper one but cannot be used for continuous operation because of its high friction. An electro-graphitic brush, operating on a silver slipring, operated with by far the least noise. Anode and cathode noise voltages are practically the same and are very low in comparison with the cathode noise voltage of a copper ring. Also, the noise voltage-versus-current curves are linear. That is, there is no tendency to develop a large value of noise voltage at very small current. *AIEE Paper No. 49-30.*

HYDRAULICS

PUMPED STORAGE INSTALLATION, *by G E Schmitt, Lower Colorado River Authority, Austin, Texas.* The second pumped storage installation in the U. S. A. will go into operation this year at Buchanan Dam, Texas. This unit was selected

(Continued on page 158)


"Best little steam trap on the market"
The Armstrong No. 800
FOR draining condensate from Sterilizers . . . Laundry Presses . . . Coffee Urns . . . Vegetable Steamers . . . Risers . . . Supply Headers . . . Radiators . . . Coils . . . Unit Heaters Dryers . . . Cookers . . . Steam Tables . . . Press Platens . . . and similar equipment in laundries, restaurants, institutions, hospitals, greenhouses and processing, food and general industrial plants.



THE little Armstrong No. 800 trap for pressures to 150 psi is the modern version of the Armstrong No. 100 trap which was introduced way back in 1931 as the first small, heavy duty, side-inlet, side-outlet mechanical steam trap ever manufactured for small drips. The most widely used industrial steam trap in the world, it is also one of the most widely imitated, but only the Armstrong No. 800 offers all these advantages:

- Interior mechanism identical in material and workmanship to that in Armstrong traps for 1500 psi, 900° F.
- *Actual tested hot condensate capacity* from 450 to 690 lbs/hr continuous, depending on pressure.
- Free-floating, frictionless leverage system.
- Hardened chrome steel valve and seat.
- 18-8 stainless one piece deep drawn bucket.
- Only 5" x 5⅛" overall; weight 4½ lbs.
- Price only $7.00 list.

The Armstrong No. 800 is *unconditionally guaranteed to give complete satisfaction or your money will be refunded.* Your local Armstrong representative carries these traps in stock and will give you prompt attention if you will call him today. Send for your copy of the 36-page Armstrong Steam Trap Book.

ARMSTRONG MACHINE WORKS, 812 Maple St., Three Rivers, Mich.

ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

For fuel savings, low maintenance, automatic air removal **SPECIFY ARMSTRONG!**

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

Mines Bureau Dedicates Two Coal-to-Oil Plants

► Two new coal-to-oil demonstration plants were dedicated by the Bureau of Mines on May 8 at Louisiana, Mo. (See POWER, June 1948, p 124.) First of their kind in this country, these new plants will employ different processes to convert coal and lignite into the high-quality synthetic liquid fuels that ultimately will free us from dependence on foreign sources of oil. They were erected at a combined cost of $15,000,000 to serve as a proving ground for American coals, equipment and processing methods.

The two processes operated at Louisiana, Mo. in combination produce liquid hydrocarbons ranging from heavy fuel oils to jet fuels and aviation gasoline. Aims of the bureau are to demonstrate the merits of the two methods for converting American coals to oils. The hydrogenation unit, first of the plants to be placed in operation, is based on the Bergius-I G Farben process. Design of the gas-synthesis unit is a modification of the Fischer-Tropsch process.

The 200- to 300-bbl daily hydrogenator is first of the new units to be completed for operation. Built under contract with the Bechtel Corp of California at a cost of $10,000,000, this plant was designed for pressures up to 10,300 psi in two major operations: (1) liquid-phase hydrogenation, which accomplishes liquefaction of coal, and (2) vapor-phase hydrogenation, which converts liquefied coal to gasoline and byproducts. Separately or simultaneously the process produces liquid fuels ranging from high-octane aviation gasoline to bunker-C oil.

A portion of the diesel oil produced in a 2-day run of the new plant was used as the fuel for operating the Burlington Route diesel locomotive that made a round-trip test run from St. Louis to Louisiana.

The second of the bureau's new units, the gas-synthesis demonstration plant, is scheduled for completion this year. Koppers Co, of Pittsburgh, Pa., received the contract for its design and construction in March 1948; cost is estimated at $5,000,000.

An 80- to 100-bbl-per-day unit, this plant will gasify pulverized coal with oxygen and superheated steam and then convert the resulting synthesis gas—a mixture of carbon monoxide and hydrogen—to liquid fuels by the indirect Fischer-Tropsch process. With American modifications, this process is well adapted to production of either a good grade of motor gasoline or an excellent diesel fuel. Product costs are expected to approximate those of the hydrogenation process.

Byproducts include wax, alcohols and hydrocarbon gases. Through cracking, the wax can be converted to diesel fuel

(*Continued on page 184*)

Coal Hydrogenation Plant at Louisiana, Mo.

This view of the coal hydrogenation plant, operated by Bureau of Mines at Louisiana, Mo., shows product storage tanks, *foreground*, distillation facilities, *left*, and converter stalls, *right*. The unit is based on the Bergius-I G Farben process

COMING EVENTS

July 4-8—Gordon Research Conference on Ion Exchange, sponsored by American Assn for the Advancement of Science, Colby Jr College, New London, N. H. W George Parks, director, Rhode Island State College, Kingston, R. I. From June 15 to Sept 1 address mail to Colby Junior College, New London, N. H.

Sept 12-16—Instrument Society of America, convention, Municipal Auditorium, St. Louis, Mo. Richard Rimbach, secretary, 1117 Wolfendale St, Pittsburgh 12, Pa.

Sept 26-28 — National Electronics Conference, meeting and exhibit, Edgewater Beach Hotel, Chicago, Ill. Karl Kramer, secretary, Jensen Mfg Co, Chicago, Ill.

Oct 3-4—National Assn of Corrosion Engineers, south central region meeting, Adolphus Hotel, Dallas, Texas. G R Olson, United Gas Pipe Line Co, Box 1407, Shreveport 92, La.

Oct 3-5 — National Lubricating Grease Institute, annual meeting, Hotel Roosevelt, New Orleans, La. Harry F Bennetts, NLGI, 4638 Mill Creek Parkway, Kansas City 2, Mo.

Oct 16-21—American Welding Society, 1949 annual meeting, Hotel Cleveland, Cleveland, Ohio. M M Kelly, secretary, American Welding Society, 33 W 39th St, New York 18, N. Y.

Laboratory illustration of good water treatment . . . and bad. Test rods, in same water, same temperature and circulation conditions, but only one with Nalco treatment added (left), show the improvement you can expect with The Nalco System.
— Nalco Laboratories Photo

Nalco

SERVICES AND PRODUCTS

- A Nalco SURVEY provides a complete water treatment picture, with recommendations if necessary.
- LABORATORY RESEARCH keeps modern chemicals and water treatment methods at work *for you.*
- PRODUCTS recommended by Nalco are designed to deliver full water treating value, in the forms best suited to your plant requirements.
- PLANT SERVICE by thoroughly experienced water treatment engineers... Keeps The Nalco System up-to-the-minute in your plant.
- TEST EQUIPMENT furnished by Nalco makes routine tests and control procedure fast and accurate.
- THE NEW NALCO SR SERIES OF PRODUCTS alleviate fire side deposits.

WHAT IS GOOD WATER TREATMENT?

WE CAN all agree that *good* water treatment should provide clean pipe lines from the raw water intake through all equipment and including condensate return lines. It should provide clean valves, cooling systems, turbines, and boiler and processing equipment free from scale, corrosion, slime and algae. Boilers should be maintained free from foam so that steam can be produced in a satisfactorily dry condition with blowdown kept at a minimum. Such a condition should be maintained on a permanent basis with a *good* system of water treatment.

This, briefly, is the Nalco idea of *good* water treatment. It is the kind of water treatment that is possible and has proven economical in thousands of plants now using The Nalco System.

For your own satisfaction, and at no obligation whatever, ask to have a Nalco field representative survey your plant so that you may decide for yourself the benefits The Nalco System has to offer.

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6222 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario

THE Nalco **SYSTEM** • **Serving Industry through Practical Applied Science**

How to plan a

CLOSED FEEDWATER HEATER SYSTEM

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

The principal application of Closed Feedwater Heaters is in regenerative stage heating of boiler feedwater in steam power plants. However, they are also used widely in industrial buildings, schools, hotels, hospitals and other institutions to heat the service water. Since the heating steam does not mix with the water in the Closed Feedwater Heater system, no impurities, odors or tastes are imparted to the water.

When used to raise the temperature of boiler feedwater with exhaust steam, bleed steam or live steam as the heating medium, the Feedwater Heater is usually the closed type shown in this layout. In this cycle, the water passes through heat exchange tubes and the steam passes around the outside of the tubes.

In power plants, feedwater pre-heating steps up plant efficiency by increasing boiler feedwater temperatures; also, it reduces the strain on the boiler that occurs when cold feedwater is used. Some of the steam passing through a power plant turbine is withdrawn at various stages, or bleed points, and goes into its own Feedwater Heater. Here it gives up its latent heat, condenses and passes into a deaerator. From the deaerator, which is at atmospheric pressure, the feedwater goes to the boiler feed pumps where the pressure is raised to that of the boiler. It then passes, at about 210° F., through a Closed Feedwater Heater like the one shown, to be heated to the highest practicable temperature.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

46

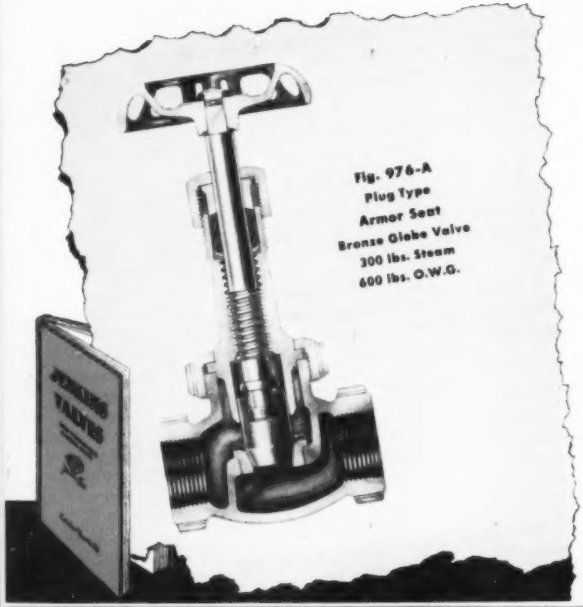

Fig. 976-A
Plug Type
Armor Seat
Bronze Globe Valve
300 lbs. Steam
600 lbs. O.W.G.

Pressures of both the boiler feedwater and bleed steam are, of course, dependent upon the design of the specific power plant. In the system illustrated, valve recommendations are for a 250 lb. boiler and bleed steam pressure of 125 lb. or less.

Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installations.

Fig. 976-A, the Jenkins Plug Type Armor Seat Bronze Globe Valve indicated in this layout, is designed for the most severe services. It is particularly suitable for pressure regulation, or any close regulation of steam that threatens wire drawing. Its 500 Brinell Armor Seat is unaffected by throttled steam, resists galling, abrasion, erosion and corrosion.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run.*

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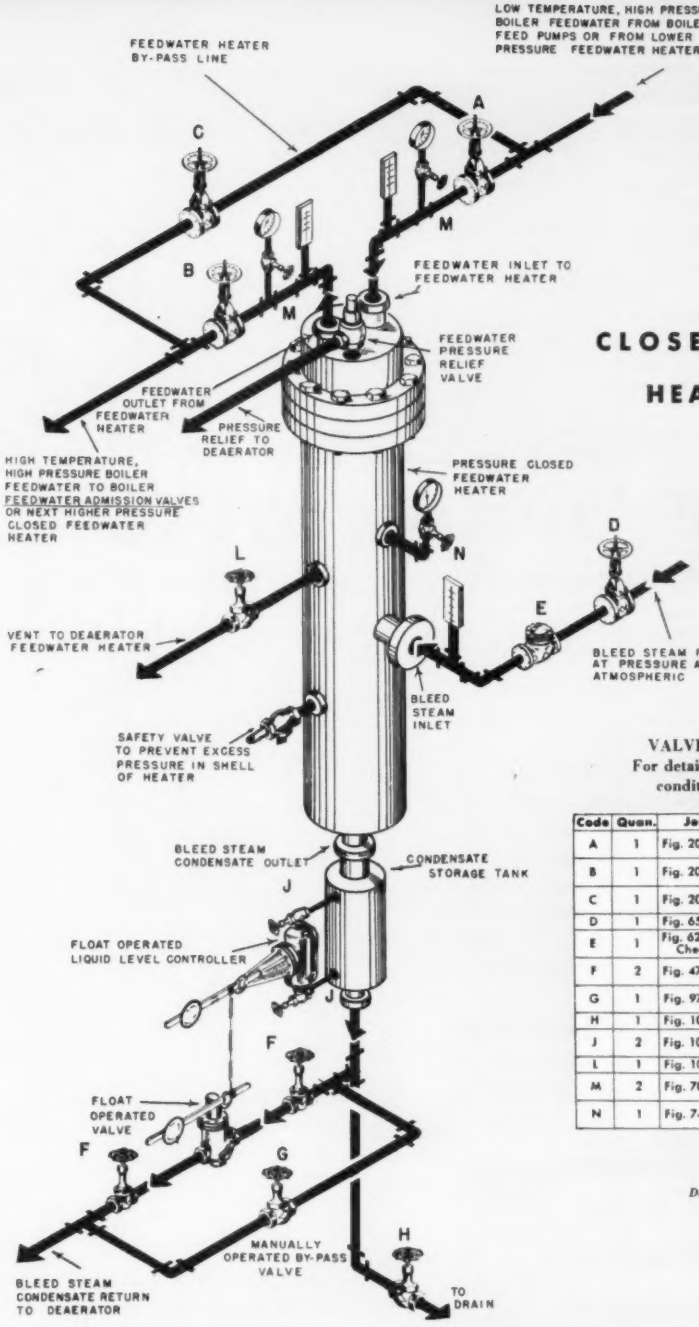

CLOSED FEEDWATER HEATER SYSTEM

VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog

Code	Quan.	Jenkins Valves	Service
A	1	Fig. 204, I.B.B.M. Gate	Feedwater Heater Inlet Shutoff
B	1	Fig. 204, I.B.B.M. Gate	Feedwater Heater Outlet Shutoff
C	1	Fig. 204, I.B.B.M. Gate	Feedwater Heater By-Pass
D	1	Fig. 651 I.B.B.M. Gate	Bleed Steam Shutoff
E	1	Fig. 624, I.B.B.M. Swing Check	Prevent Backflow to Turbine
F	2	Fig. 47, Bronze Gate	Shutoff Float-Operate Valve
G	1	Fig. 976-A, Bronze Globe	Manually Operated By-Pass
H	1	Fig. 106-A, Bronze Globe	Storage Tank Drain
J	2	Fig. 108-A, Bronze Angle	Liquid Level Controller Shutoff
L	1	Fig. 106-A, Bronze Globe	Shell Vent Shutoff
M	2	Fig. 703 Bronze Needle	Feedwater Pressure Gage Shutoff
N	1	Fig. 743-G Bronze Needle	Shell Pressure Gage Control

Diagram by Huxley Madeheim Consulting Engineer

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VALVES

125 TO 600 LBS. STEAM PRESSURE

BRONZE • IRON • STEEL

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SOLD THROUGH RELIABLE INDUSTRIAL DISTRIBUTORS EVERYWHERE

Selecting Pipe Schedules Quickly

► BRANCH PIPELINES are often of the same schedule as the main line to which they connect. When working stresses are within allowable limits, lower schedule numbers can be used at less expense. These curves enable the designer to select the most economical schedule for smaller branch lines without the need of checking stresses. They are based on the pipe-design formula of the code for pressure piping ASA-B31.1:

$$t = \frac{PD}{2S + 0.8P} - C$$

The curves solve the equation,

$$t_2 = t_1 \frac{D_2}{D_1} - C\left(1 - \frac{D_2}{D_1}\right)$$

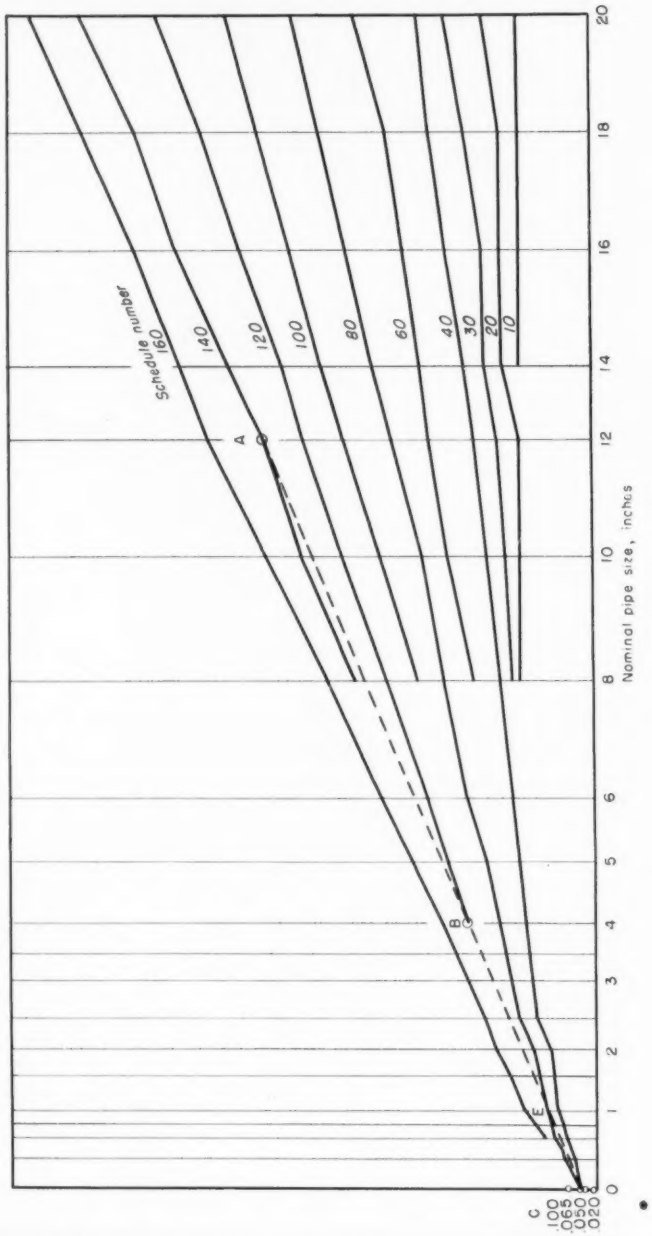
Subscript 1 refers to the main pipeline and 2 to the branch line.

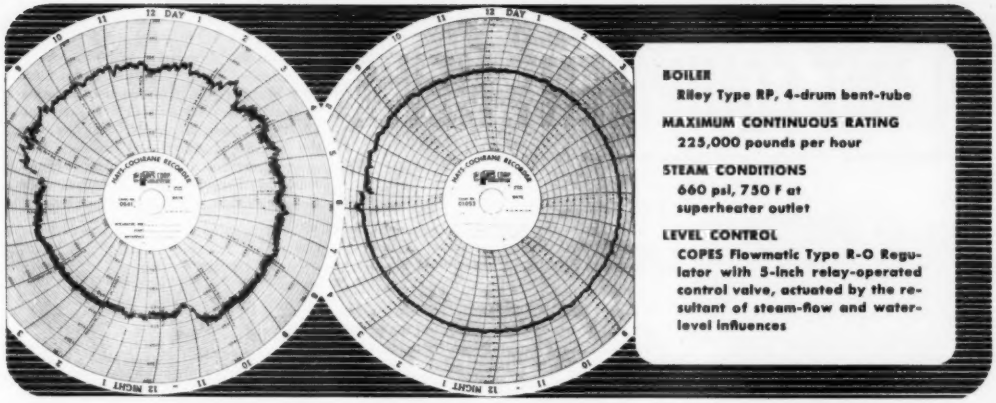
To use the curve, first locate a point such as *A*, corresponding to main pipe diameter and schedule number. Next locate point *C* with the value corresponding to the code specification for the installation. Then draw a straight line between these two points. All pipe schedules and sizes on the line will have the same stress. Schedules above the line will have lower, and those below higher stress.

Example: Main pipeline is schedule No. 140, 12-in. dia. C = 0.065. With this data draw the straight dotted line *ABE*. Then the corresponding branch pipes that can be used are:

Diameter, inches	Schedule No.
8 to 12	140
Above 4 to 8	160
4	120
Above 1 to under 4	160
1 and below	80

By M W LARINOFF *New York, N. Y.*





BOILER
Riley Type RP, 4-drum bent-tube

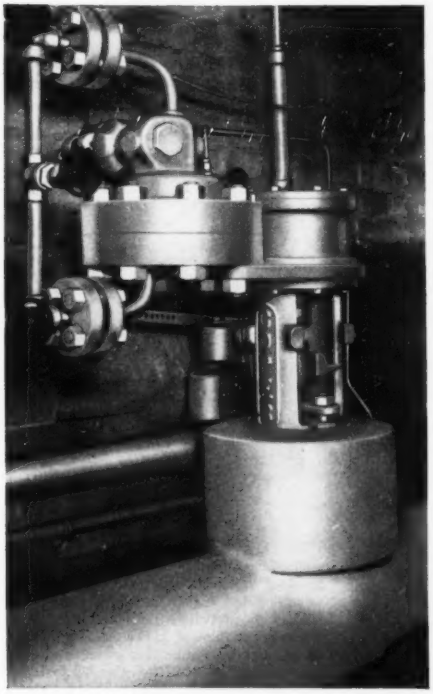
MAXIMUM CONTINUOUS RATING
225,000 pounds per hour

STEAM CONDITIONS
660 psi, 750 F at superheater outlet

LEVEL CONTROL
COPES Flowmatic Type R-O Regulator with 5-inch relay-operated control valve, actuated by the resultant of steam-flow and water-level influences

COPES FLOWMATIC TYPE R-O*

HOLDS CLOSE BOILER WATER LEVEL WITH CONSTANTLY-SWINGING LOADS



*R-O means relay operation, with the COPES Valve built to absorb pressure drops of 2000 psi or more, if necessary under abnormal operating conditions. The flow-responsive element is mounted on the valve, with direct mechanical link to the level-responsive element or COPES Thermostat.

If your boiler loads are constantly swinging, take a tip from this well-known industrial plant. Here load fluctuates constantly, swings averaging 10,000 pounds per hour. With total load range from 150,000 to 265,000 pounds per hour, the total water-level variation was no more than plus-or-minus one inch.

You'll find the complete story of this important installation in Performance Report 485. Write for your copy. See for yourself what results you can expect when you entrust the feed control of your modern boilers to experienced COPES Engineers.

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791 GROVE DRIVE, ERIE, PENNSYLVANIA
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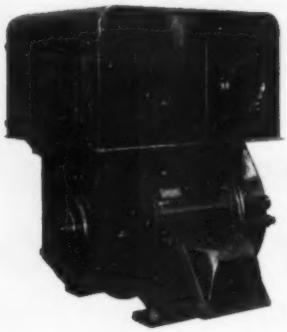
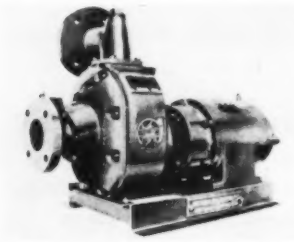
PLANT EQUIPMENT NEWS

Published monthly as a service to readers



P703 • UNIT-COOLED DC MOTOR—Two blowers driven by a single induction motor in the air-to-air cooling assembly provide ventilation independent of motor speed. One blower circulates internal air through the motor and unit cooler while the other blows external air through cooler.

Motor air never comes in contact with contaminated outside air. Designed for operation in dusty, dirty, and oil-laden atmospheres, the totally-enclosed, unit-cooled motors require no piping, duct-work, air filter, or pressurized air supply.
General Electric Co, Schenectady 5, N. Y.

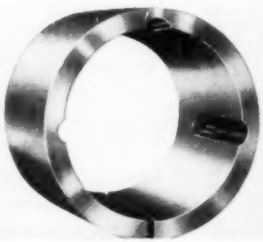


P730 • SELF-PRIMING PUMPS—New line of long-coupled, also vertical and horizontal close-coupled motor-driven pumps, has been developed. They can also be driven by belts or internal-combustion engines in stationary and portable models.

Priming is by a diffuser which permits the pumps to prime automatically. These pumps handle a wide range of liquids from clear water to fluids of 500-ssu viscosity. Capacities range from 15 to 3500 gpm at heads of 15 to 170 ft. Pumps are standard in cast iron or welded steel, but can be had in other metals for special requirements. Motor ratings are from ½ to 60 hp, mounted with the pumps on welded steel frames or on wheels.
Marlow Pumps, Ridgewood, N. J.

P756 • ELECTRODE—Short, intermittent welds at high speeds on all gages of steel in any position can be made with Class *E*-6013 electrode, using either ac or dc, straight or reverse polarity.

Electrode has fast operating characteristics, a forceful spray-type arc that can be easily started and restarted without scraping or hitting the electrode against work surface. Hobart No. 313 electrode is available in (1) 12-in. lengths in 3/32 in. only packed in 25-lb containers (2) 14-in. lengths in 1/8, 5/32 and 3/16 in. sizes packed in standard 50-lb containers.
Hobart Bros Co, Hobart Square, Troy, Ohio.

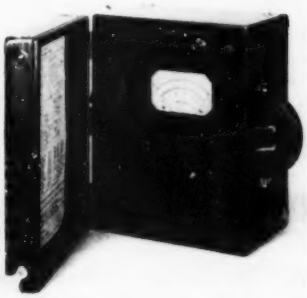


P732 • BUSHING ADAPTER—Adapters for taper-lock bushings are recommended where it is more convenient to use a straight bore in the hub than to drill and taper bore hubs to accommodate the bushings.

These adapters consist of a taper-bore sleeve that fits into straight bore of the hub. Bushing slips inside of adapter that is tapped for the bushing screws. When tightening locking screws in bushing, the adapter is expanded against hub bore and contracts bushing onto shaft to a press fit on all surfaces. Taper bushings are used in V-belt sheaves, sprockets, gears and other equipment to lock them onto their shafts.
Dodge Mfg Co, Mishawaka, Ind.

P736 • CATION RESIN—*Amberlite IR*-120 resin has an absorptive capacity of 30 kilograms per cubic foot and can handle flow rates of 25 gal per sq ft per min in a bed 30 in. deep.

Used for water softening and special processing applications, the resin is said to show no deterioration in waters of low silica content. Immersion in boiling water, for extended periods of time and contact with strong oxidation-reduction solutions at elevated temperatures (190 F), does not affect the resin adversely. Stability over the entire pH range and freedom from color throw are additional characteristics.
Resinous Products Div, Rohm & Haas Co, Bridesburg, Philadelphia, Pa.



P720 • INSULATION TESTER—*Megotron* Model 101 is an electronics rectifier type, dual-voltage, 3-range instrument for measuring insulation resistance. Unit is suitable for short-time or dielectric absorption tests.

Instrument operates from a 110-130 v, 50-60 cycle lighting circuit and supplies either 500 or 1000 v output. Ranges at 500 v are .1-5, 3-200 and 15-2000 megohms.
J W Dice & Co, Grand View-On-Hudson, N. Y.

P755 • UNIT HEATER—Squirrel-cage fan supplies heated air from a gas-fired unit heater, Series *CB*, at greater velocities and higher pressures than possible with propeller-type fans.

Pittsburgh blower has a cast-iron heat exchanger and combustion chamber. Both are cast in one piece. The extended surface fins on the heat exchanger are cast integral. Unit comes in five sizes with AGA outputs of 172,000, 136,000, 112,000, 84,000 and 68,000 Btu per hr.
Automatic Gas Equipment Co, 301 Brushton Ave, Pittsburgh 21, Pa.

(*Continued on page* 142)

For further data on above items use reply cards on page 186a, identifying your request with letter *P* and number

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ONE SOURCE OF SUPPLY
RESPONSIBILITY
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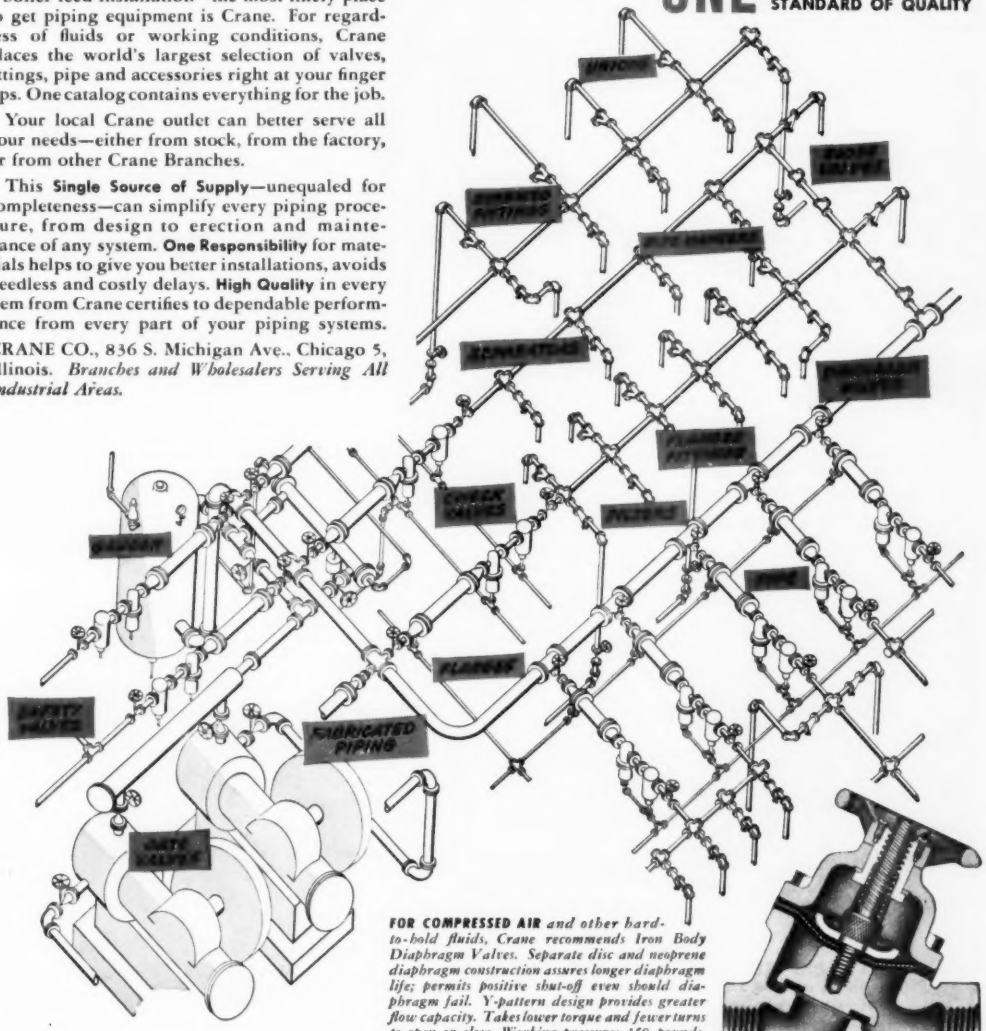

FOR COMPRESSED AIR *and other hard-to-hold fluids, Crane recommends Iron Body Diaphragm Valves. Separate disc and neoprene diaphragm construction assures longer diaphragm life; permits positive shut-off even should diaphragm fail. Y-pattern design provides greater flow capacity. Takes lower torque and fewer turns to open or close. Working pressure: 150 pounds, max.; 180 deg. F. max. Sizes: ½ to 4-inch. Write for folder AD-1761.*

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VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

EQUIPMENT NEWS CONTINUED

P711 • PORTABLE MG SET—Portable 300 kw motor-generator set, complete with auxiliary control switchgear, generates dc power for mining coal. Factory-assembled in two electrically inter-connected skid-mounted packages and driven by a 2300-v 450-hp synchronous motor, the mg set is capable of handling a 25% overload for two hours and 100% overload for one min.

Excitation for the synchronous driving motor is taken from the generator circuit. The dc generator is compound wound, interpole design, self-excited. Each machine, equipped with its own anti-friction bearings, is flexibly coupled and mounted on a specially designed rigid base.

Reliance Electric & Engrg Co, 1088 Ivanhoe Rd, Cleveland 10, Ohio

P752 • STEAM-JET CLEANER—Easily portable, fully automatic *JC-30 Speedy-lectric* provides an effective steam-detergent cleaning unit for industrial service.

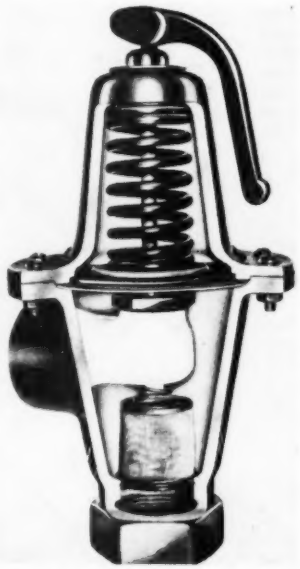
Using high-pressure steam from a built-in electric boiler to mix with a proper amount of detergent at the jet makes certain no excess water dilutes the detergent or floods the working area. Unit weighs about 500 lb and mounts on an all-steel dolly with ball-bearing rubber-tired swivel casters. It operates on ac, 220 v and over, single or polyphase, with a boiler capacity of 30 kw.

Livingstone Engrg Co, 100 Grove St, Worcester, Mass.

P704 • CIRCUIT BREAKER—A line of Type *DB* 600-v dc or 250-v ac circuit breakers have accurate tripping characteristics for low-voltage power distribution in industrial plants, motor-starting duty, etc. Accurate control for long-time delay with tampering protection is provided by a unique time-delay element assembled in a hermetically sealed tube.

Two frame sizes are available. *DB*-15 has an interrupting rating of 15,000 amp with load current ratings up to 225 amp at 600-v ac or 250-v dc. *DB*-25 is rated for load currents up to 600 amp with an interrupting capacity of 25,000 amp.

Westinghouse Electric Corp, 306 Fourth Ave, Pittsburgh 30, Pa.



P745 • RELIEF VALVE — *B&G* combination safety and relief valve No. 300 is constructed according to the present ASME Code and is rated by them to have a capacity of 318,000 Btu per hr. Suitable for heating systems, the valve discharges about 10 gal of water per hr at low flow.

When wide open and with 30 psi at the valve inlet, it discharges 7 gal per min. With 33-psi inlet pressure it discharges 11¼ gal per min.

Both the valve seat and disk are of monel metal, ground and polished to assure tight closing. Valve has a safety strainer to remove all foreign matter, such as pipe chips, etc.

Bell and Gossett Co, 8200 N. Austin Ave, Morton Grove, Ill.

P712 • ELECTRICAL INSULATION—A new series of heavy-duty Fiberglas-reinforced *Glastic* electrical insulating laminates has all the requirements of high-impact Class B insulating plate materials, plus flame resistance. These materials possess a unique combination of high rigidity, impact strength, arc and flame resistance, heat resistance, and low moisture absorption.

Glastic plate materials are available in standard thicknesses from 1/32 to 1½ in. and in sheets 36x48 in.

Laminated Plastics, Inc, 14838 Euclid Ave, Cleveland 12, Ohio.

P759 • ALUMINUM WELDING — Greater strength aluminum welds free of distortion result from use of *Eutec-Aluminum-Weld*.

Designed as thin-flowing alloy for use with *Eutector Flux*, lap and slip type welds become easy to make. *Eutec-Aluminum-Weld* bonds readily to the surface, gives a clean, smooth weld that requires no after-machining and has a corrosion-resistant property.

Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y.

P708 • PLASTIC ELECTRICAL TAPE—*Polyken* No. 822 is a plastic-backed electrical adhesive tape with a dielectric strength of over 10,000 v. This tape is suitable for use in place of the combination of splicing tapes or compounds and friction tape.

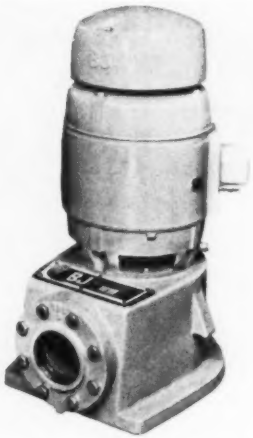
The new tape has insulation and electrical characteristics of its parent material, polyethylene, and is ten times more resistant to moisture than vinyl tapes.

Polyken, Dept F, Bauer & Black, 222 West Adams St, Chicago 6, Ill.

P733 • FLEXIBLE COUPLING—For connecting fractional-horsepower motors an all-rubber center coupling has been developed. Flexing caused by misalignment is taken by the center member.

Tight fit of the coupling pins, when pressed into the rubber center member, eliminates noise and vibration. Shock loads are cushioned to increase bearing life.

Morse Chain Co, 7601 Central Ave, Detroit 8, Mich.

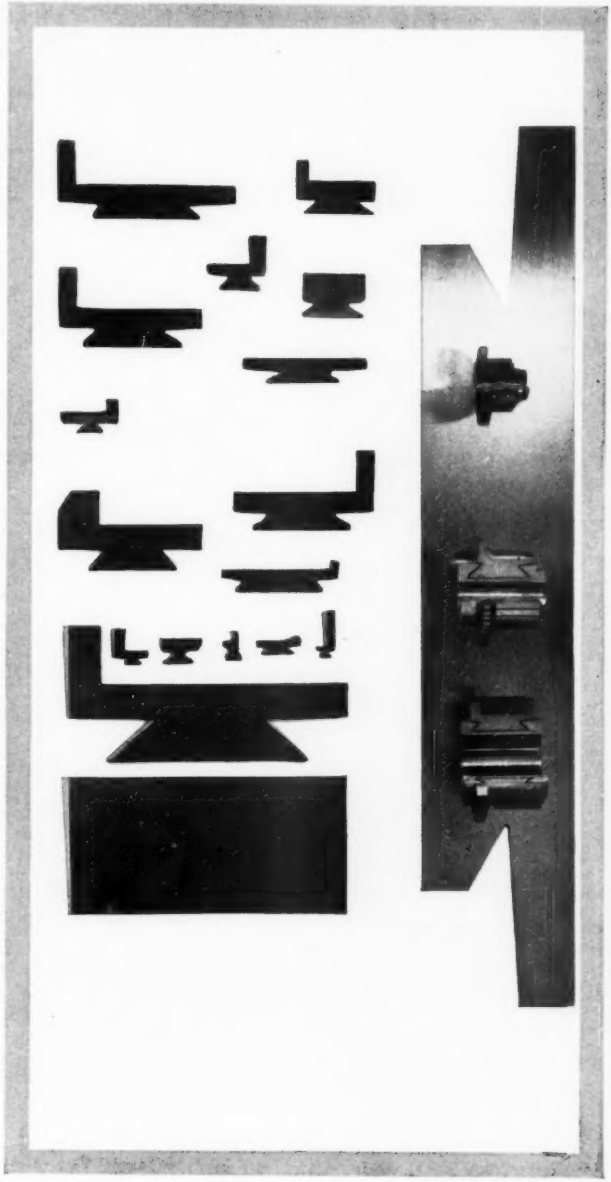


P728 • DEEPWELL PUMPS—Available for different well diameters, capacities and heads, three assemblies fit wells from 6 to 24 in., or larger, in diameter.

Several impeller designs are standard for each size of three bowl types. More than 100 impeller designs of different

For further data on above items use reply cards on page 186a, identifying your request with letter P and number

REVERE OFFERS YOU
COMMUTATOR COPPER
IN LENGTHS OR SEGMENTS



REVERE does not make commutators, but furnishes commutator copper in the form you require it—in lengths of the proper cross section, ready for you to cut, or in segments which can be assembled with a minimum of finishing in your plant. The illustration shows some of the sizes, large and small, for use in large generators, or in fractional horsepower motors.

Revere Commutator Copper is available in Electrolytic, OHFC (Oxygen-Free High Conductivity), or Silver-Bearing Copper, depending upon conditions of service. Selection of the proper metal or alloy naturally depends upon conditions of use. Careful choice is particularly important in modern motors of small size and light weight, turning over at high speeds.

Revere's long manufacturing experience, and detailed understanding of the problems involved have been turned to excellent account by many manufacturers. We will gladly work with you in selecting the proper material for your commutators. Write Revere.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.

Sales Offices in Principal Cities, Distributors Everywhere.

hydraulic characteristics are provided. Pumps adapted to belt, gear or direct-mounted electric motor drive.
Byron Jackson Co, Terminal Annex-Box 2017, Los Angeles 54, Calif.

P735 • DRUM HANDLER—This wheel-about vehicle lifts, transports and releases any size steel drum, wood barrel or cylindrical fiber container. It is available for loads up to 850 lb in 50- to 60-gal sizes.

It picks up the container, carries it in an upright position and sets it down easily without tilting. Open containers can be carried without risk of spilling. Scarcely wider than the drum, the vehicle can be operated in close quarters. The lever-handle, after lifting load and actuating safety lock, becomes a free-swinging steering column.
Ernst Drumobile Div, Brantwood Products, Inc, 115 Brayton St, Buffalo 13, N. Y.

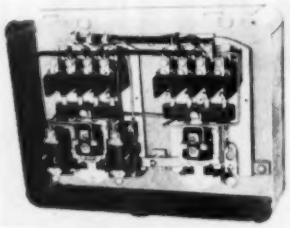
P722 • VARIABLE-SPEED UNIT—Speed-control unit operates from 110 or 220 v ac source. The ac is rectified and fed to dc motor. Armature voltage is a function of motor load or specific instructions from operator.

Normal speed-range ratio is 20 to 1. Control unit has an extra switch to start and stop the motor without disturbing speed setting.
Servo-Tek Products Co, 4 Godwin Ave, Paterson 1, N. J.

P717 • COMPENSATED RELAY—Incorporating a bimetal element this relay operates at a constant voltage regardless of temperature or at decreasing voltage with increasing temperature. Unit was developed for battery charge control where operating voltage must decrease with rising temperature. Windings are available for all common charging voltages.
Sigma Instruments Inc, 45 Ceylon St, Boston, Mass.

P721 • SOLDERING TOOL—*Solderweld* heats the work in a fraction of the time required with conventional iron. Unit operates at 6 v and draws 40 watts.

Automatic tip action opens the circuit when the device is not in actual contact with work. Device is portable (weighs 6 oz) and may be operated from transformer or battery.
Palmer Mfg Co, 366 Madison Ave, New York 17, N. Y.

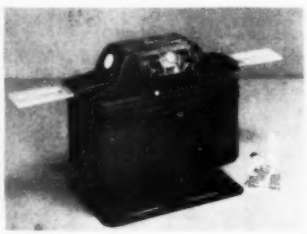


P713 • MOTOR REVERSING STARTER—Designed for industrial control applications such as machine tools, woodworking machines, etc, these three-pole starters are suitable for across-the-line starting and reversing of polyphase motors to 200 hp, 550 v 60 cycles, inclusive.

Starters consist essentially of two magnetic contactors interwired for reversing operation, mechanically interlocked, with or without thermal overload protection. They are built for inching, jogging or plug-stop as well as direct reversing service.
Ward Leonard Electric Co, Mt. Vernon, N. Y.

P743 • BRONZE VALVE—Fig. 2140 globe valve and Fig. 2141 angle valve have a malleable iron non-heating handwheel, identifying nameplate, machined repacking seats, and solid bronze disks that are renewable on ¾-in. size and larger. Stems are of silicon bronze alloy.

Check valves Fig. 2142, lift check, and Fig. 2144, swing check, have similar features. Fig. 2142 has guide lugs on the disk and guide sleeves in the cap to assure positive seating. Fig. 2144 has two renewable side plugs to serve as bearings for the disk-carrier pin.
Lunkenheimer Co, Cincinnati, Ohio.

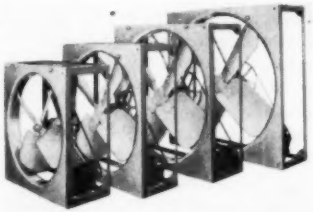


P701 • CURRENT TRANSFORMER—A butyl-molded transformer, the *JKM-3* is for accurate indoor metering and relay services. Rated 5000 v at 25-60 cycles, it is available with single primary in all preferred ratings, 10 to 800 amp inclusive.

Butyl compound, injected under high pressure into the areas around core, coils and terminals, provides a homogeneous insulation that is resilient, oxidation-resisting, arc-resisting, and highly resistant to moisture. Primary terminals are silver-plated to reduce contact resistance. Secondary terminals are of the solderless clamp type.
General Electric Co, Schenectady 5, N. Y.

P727 • CONDENSATE PUMP—Package unit handles heating systems of 500 to 8000 edr at 20 psi. It can fit into any corner of a basement. Inlet for returns is only 9.5 in. above floor line. It may be totally encased by concrete in a pit with the return inlet at the floor line.

Corrosion-resistant gray-iron receiver of 10-gal storage capacity has a bronze basket strainer removable for cleaning and a float switch with maximum setting for 7 gal between start and stop. A 12-gpm pump has cast-iron casing mounted on top of receiver. A bronze impeller attaches directly to motor shaft and a mechanical-shaft-seal eliminates packing. Unit is powered by a capacitor-type vertical ball-bearing, totally enclosed ¼-hp motor. Overload protection is built into the motor.
American Hydrovac, Inc, 290 Scholes St, Brooklyn 6, N. Y.



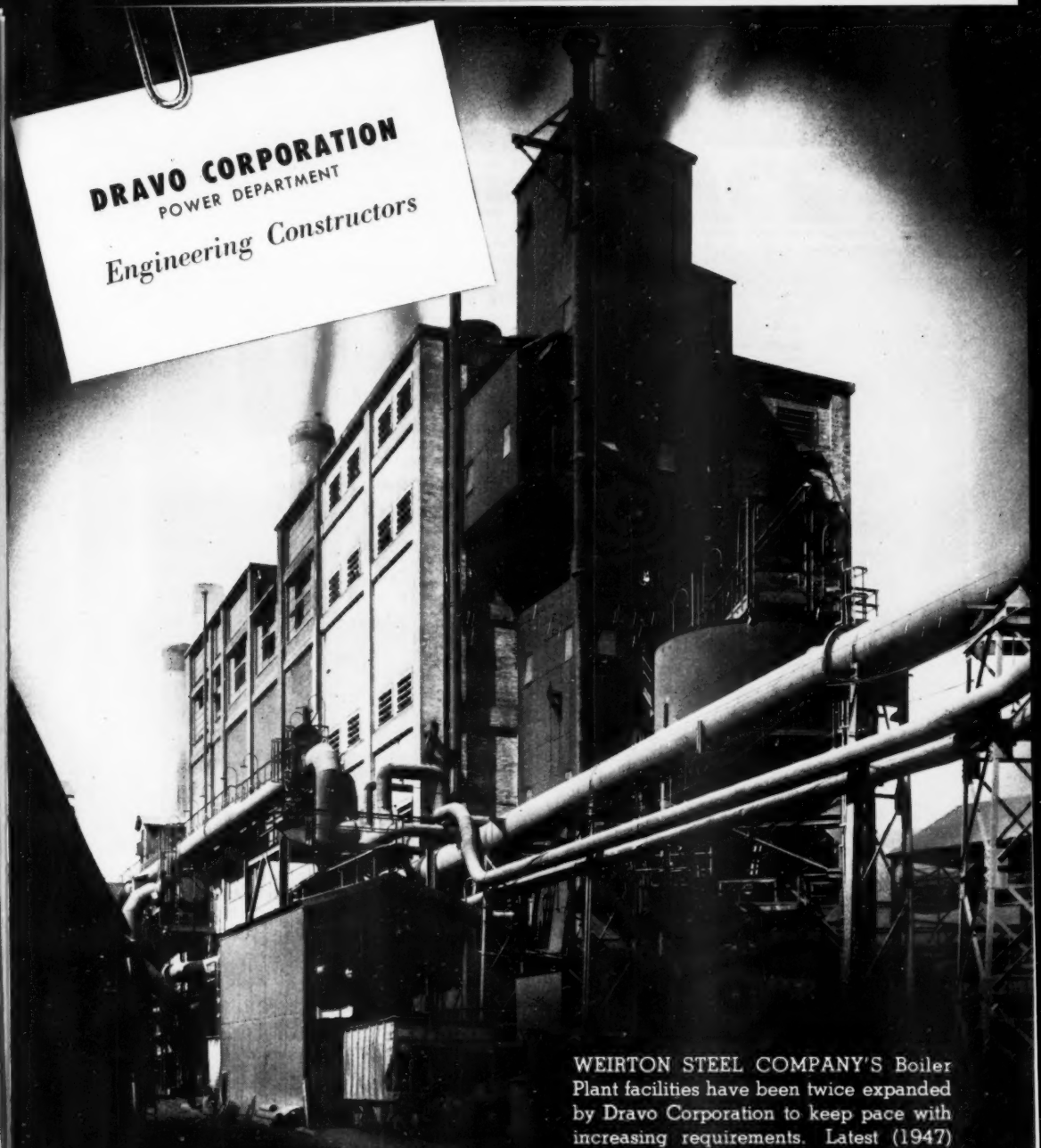
P761 • AIR VENTILATORS—Wall-mounted *Niteair* blower panel units employ self-aligning pillow blocks on *Durex* bronze bearings that hold shafts rigid when operating.

Units are statically balanced and come in a range of sizes from 30 to 48 in. with air deliveries from 7611 to 17,564 cfm.
Lau Blower Co, Dayton 7, Ohio.

P744 • MAGNESIUM ANODE—Numerous types and forms of magnesium anodes are available for cathodic protection against corrosion. Type to choose depends on application involved and soil or water conditions encountered.

Type *1B* cast anode has a rating of 1 amp year and will last ten years at a continuous anode current output of 0.99 amp in soil or water with a resistivity of about 2000 ohms per cu cm. Under the same conditions, Type *3B* and *5A* cast anodes should last about 20 and 30 years, respectively. *Galvo-Pak* units consist of Types *1B* and *3B* anodes packed with a specially prepared quick-wetting backfill material in cloth sacks. Anodes come ready to install. *Galvo-Line* is a flexible,

For further data on above items use reply cards on page 186a, identifying your request with letter P and number



WEIRTON STEEL COMPANY'S Boiler Plant facilities have been twice expanded by Dravo Corporation to keep pace with increasing requirements. Latest (1947) extension adds another complete unit to the high pressure boiler plant and 325,000 lbs. per hr. to steam output. Dravo-built boiler plants serve companies which produce more than 47% of the nation's steel.

DRAVO
CORPORATION

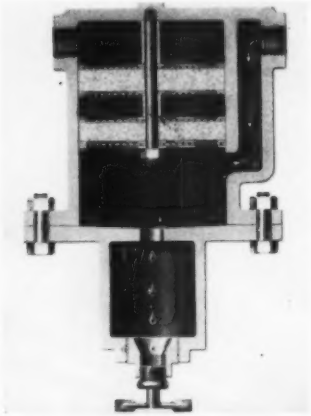
DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations—fabricators and erectors of power piping—power and boiler plant equipment.

PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK · DETROIT

EQUIPMENT NEWS CONTINUED

cored magnesium ribbon that has a high surface area to weight ratio. It supplies from three to seven times as much current per pound of magnesium installed as the conventional cast anode. *Galvo-Rod*, an extruded, cored magnesium anode developed for use in domestic hot-water heaters, can be used often to bridge the rather large gap in life expectancy between cast anodes and *Galvo-Line*. It comes in three diameters with ratings from 200 to 500 amp hr per ft.
Dowell Inc, Tulsa 3, Okla.



P746 • SEPARATOR — Murphy *Paragon C* separator removes oil, moisture and dirt from compressed air at the point of use.

Unit comes in two sizes. Size 1 accommodates inlet and outlet pipe sizes of ⅛ to ⅜ in. and delivers to ⅛-in. pipe nozzle only. Size 2 accommodates inlet and outlet pipe sizes of ⅜ to ¾, and delivers by manifold to four ⅛-in. pipe nozzles or to two ¼-in. nozzles. Separator consists of an expansion chamber and strainer cartridge. Strainer cartridge may be removed, cleaned and reused. Moisture can be drained periodically by hand, or the drain plug may be cracked to allow escapement of the fluid.
James A Murphy & Co, 5th & Fine St, Hamilton, Ohio.

P750 • WELDING CABINET—Compact, 22x13x3-in. metal cabinet, *Eutec-Wall-Pack* accommodates from seven to nine different low-temperature welding alloy rods in standard packages.

Principal user for such a utility cabinet will be the small-shop owner who needs a variety of rods but cannot purchase them in the standard, large quantities now available to industry. There is a choice of three models, complete with *Eutector Flux* for lowest heat applications and *Economizers*, handy packets with a coil of alloy in one compartment and a jar of flux in the other. One model applies for torch-welding equipment only, a second for arc-welding only, and a third for both.
Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y.

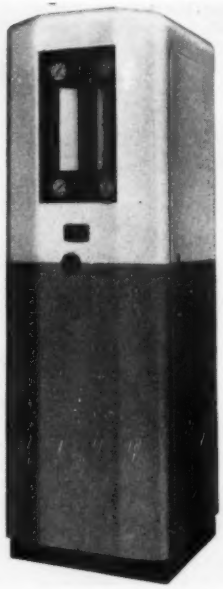
P734 • ROTARY WIRE BRUSH — Steel bristles, embedded in rubber center, feature this rotary brush. Rubber core permits bristles to flex over a gradual arc for their full length to eliminate fatiguing. Flexibility of rubber core returns bristles to upright position after each contact of a surface with a brush.

Because of an almost complete retention of the wire bristles in the rubber the number of flying wire points are greatly reduced, thus making the brush a much safer tool to work with.
Hewitt-Robbins, Inc, Buffalo 5, N. Y.

P707 • ELECTRICAL TAPE — Electrical adhesive tap No. 163 has a dielectric strength of 2000 volts. It is a good moisture barrier, yet has equal tensile strength compared to friction tape. Bulk-free insulation qualities result from its high dielectric strength combined with exceptional thinness.
Industrial Adhesive Tape Department F, Bauer & Black, 222 West Adams St, Chicago 6, Ill.

P716 • TROUBLE LIGHT—Insulated caged trouble lamp has a radius of 25 or 45 ft from it's reel rack. The retractable neoprene-jacketed kinkproof cord automatically locks at the desired length.

After use, tugging the cord releases ratchet, and cord retracts into reel. Unit may be fastened to the ceiling or wall for a permanent installation, or simply laid on its side and held in place by the three suction-cup rubber feet.
M Black Mfg Co, 300 N 3rd St, Philadelphia 6, Pa.



P741 • CHLORINE FEEDER—*Chlorinizer* is designed to meter chlorine gas and produce chlorine-water solutions. A positive chlorine rate indicator with direct reading linear scale is provided.

Chlorinizer can be adapted to semi-automatic, program or automatic proportional operations, and conversion from one method of operation to any other may be made in the field.
Builders-Providence, Inc, Providence, R. I.

P719 • BEARING GREASE — This grease offers high resistance to oxidation in storage, as well as in service, in addition to being insoluble in water. It will not emulsify or aerate in presence of condensed moisture. Grease is supplied in tubes for convenient servicing in the plant as well as in larger quantities.
Norma-Hoffman Bearings Corp, Stamford, Conn.

P731 • ROTARY PUMP—For fast loading or unloading of fuel oil, gasoline or diesel fuel, this pump is built to operate out of doors without protection against weather. Pump, with stainless-steel shaft, has gearing and motor totally enclosed.

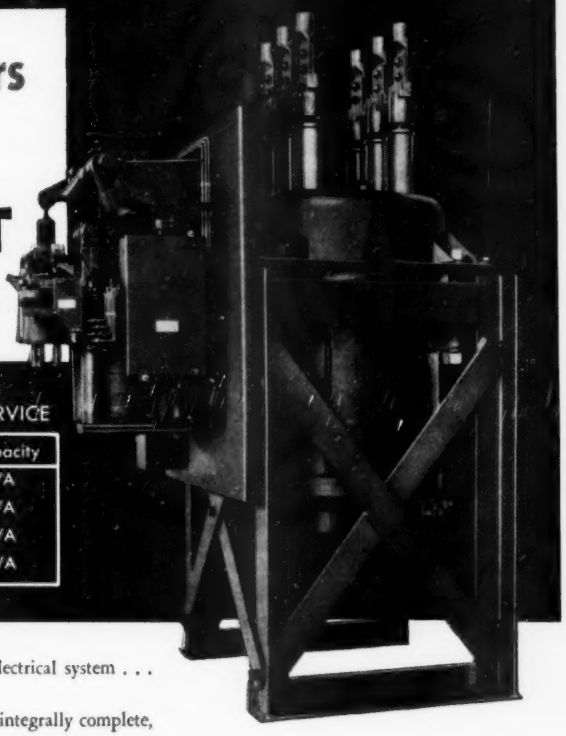
Gast-iron gear case has bull's-eye sight

(*Continued on page* 168)

For further data on above items use reply cards on page 186a, identifying your request with letter *P* and number

SAVE ☞ DOLLARS ☞ SPACE

with Allis-Chalmers Type DZ INDOOR OIL CIRCUIT BREAKERS



FOR 2.3 TO 14.4 KV SERVICE

Type	Interrupting Capacity
DZ-40B	100,000 KVA
DZ-60B	150,000 KVA
DZ-100B	250,000 KVA
DZ-200B	500,000 KVA

HERE'S ECONOMICAL PROTECTION for your electrical system . . . with minimum space requirements.

"DZ" breakers are economical because they're integrally complete, with supporting framework, solenoid operator, control relay and auxiliaries — ready for installation. They can readily be used to replace existing breakers, in *existing cell structures*, where larger interrupting capacities are required.

They're space-saving, because they're compactly designed. Whether you're expanding or revising your present system . . . or installing a *new* system . . . remember that space requirements can be kept to a minimum with compact "DZ" protection.

Send coupon today for detailed information on Allis-Chalmers dollar-and-space-saving "DZ" oil circuit breakers. Or contact your nearby A-C sales representative.

GET DZ BREAKERS IN THESE MOUNTING ARRANGEMENTS

- ✓ Cell Mounted
- ✓ Frame Mounted
- ✓ Flat Surface Mounting
- ✓ Vertical Lift Metal Clad Switchgear

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

ALLIS-CHALMERS, 952A SO. 70 ST
MILWAUKEE, WIS.

Please send bulletins 7186129 and 7186179, giving specifications and dimensions of DZ Breakers.

Name

Title

Firm

Address

City State

A-2750

Under the Upholstery

Up in Maine last summer Mama bought some mid-Victorian chairs. So since about Christmas I've been working weekends and holidays and some evenings taking them down to the wood and refinishing the frames. If I do say it, they're pretty nifty.

The toughest part of the job is taking off the old upholstery. It always is. I know one of my friends and faithful readers will chuckle a fervent amen. He has taken off 25 pounds and has 20 to go.

As I ply my tack puller, with which I've become singularly adept in that I haven't nicked a finger through the last two chairs, I find I am uncovering a lot of things besides the frames.

I go about this job almost reverently. I do not hum or whistle because I am seeing the honest workmanship that was done under the upholstery some 75 years ago, and listening to the voices of men who did it and who long since have laid aside their tools.

No day laborers these, starting and stopping with the toot of a whistle or the clang of a gong. No time clock governed their hours, no labor boss stood over them to check and curb their work.

So they put in more than time—they put a part of themselves into every job they did—*under the upholstery.*

They didn't have to drive so many tacks under the gimp so the covers would stay on years longer than was needed. But they did.

They didn't have to tie the springs so well or fasten the webbing so securely as to stand 50 years of sitting without a single sag. But they did.

They didn't have to shape and glue the joints to serve generations then unborn. But they did. And all under the upholstery where nobody could even see it but the workmen themselves—and their God.

So as I go on with my own task I feel the eyes of those old, honest workmen still fixed on me with a challenge to match my workmanship with their own. And the frames get a little more sanding and rubbing down than if I hadn't seen what was *under the upholstery.*

I stroke on the final coat of wax, buff it down with an electric buffer and give it a final polish with an electric polisher. The man who made the chair had no such gadgets; he worked by candle light, but with skillful hands and an honest heart.

I think I'm through and stand back to admire the job. I feel a reproachful look and hear voices again. I put on another coat of wax.

I've asked the author of the above, Roy Eastman, for permission to use his material on this page because he has expressed so well the fundamental of building true value into the product we make . . . the things we do.

Take the magazine you're reading now, for example. The fact that you go through its pages every month is no accident. Readership has been built into the frame and underpinning by skillful editors, who have to be handy with the oil and wax, too. For while a good foundation makes the thing stand up, it takes a good finish to make it sell.

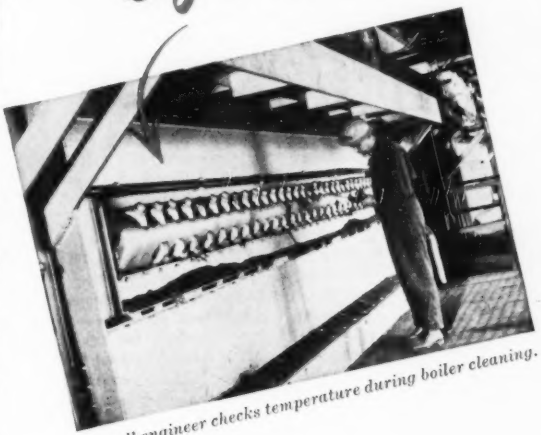
George Edwards

Engineer

DOWELL

SERVICE SPECIALISTS IN MAINTENANCE CLEANING PROBLEMS

Big Boiler Cleaned in ONE DAY by Dowell Service!



Dowell engineer checks temperature during boiler cleaning.

Quick, Effective Maintenance Service Cuts Total Down Time in Half

A TYPICAL EXAMPLE of the economies afforded by Dowell Service is reported in the case of a midwestern refinery using five 300,000 lb. per hour boilers to generate electrical power. Before Dowell Service was used in the plant, boilers were usually down two weeks whenever repairs became necessary—during which time electricity was purchased from an outside source. Using Dowell Service to do the internal surface cleaning, the boiler is back in use in one week instead of the usual two! And the Dowell part of the operation takes just one day!

Dowell Service, using the experience of thousands of successful jobs, offers you the solution to maintenance problems of this type. It is backed by strong, continuous research programs, both in Dowell's own laboratories and in those of The Dow Chemical Company. This research provides the means for an improving service with an increasing degree of effectiveness and safety.

When you call on Dowell Service for your maintenance cleaning, experienced Dowell engineers do the job for you. They bring the special equipment—truck-mounted tanks, mixers, heaters, and proportioners—necessary for controlled cleaning. No dismantling or scaffolding is required. Liquid solvents are pumped into the equipment through regular connections. Down time is held to a minimum.

For quick, practical, economical cleaning of boilers, heat exchange equipment, water lines and water wells, call the nearest Dowell office. Free cost estimates gladly given.

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

CALL

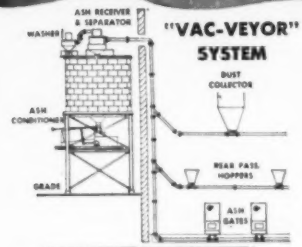
New York 20 · Boston 16 · Philadelphia 2 · Baltimore 18 · Wilmington 99 · Richmond 19 · Atlanta · Buffalo 2 · Cleveland 13 · Pittsburgh 19 · Detroit 2 · Chicago 2 · St. Louis 8 · Indianapolis · Louisville · Kansas City 8 · Wichita 2 · Oklahoma City 2 · Houston 2 · New Orleans 12 · Ft. Worth 2 · Shreveport 69 · Anniston, Alabama · Mt. Pleasant, Mich. · Hamilton, Ohio · Charleston 27, W. Va. · Salem, Illinois · Borger, Texas · Midland, Texas · Wichita Falls, Texas · Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

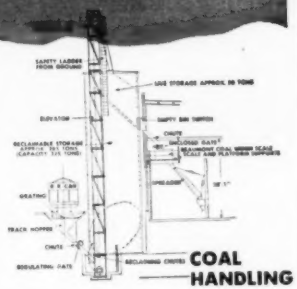
A SERVICE ORGANIZATION

Profits Saved AT EVERY STAGE . . . WITH BEAUMONT COAL & ASH HANDLING EQUIPMENT



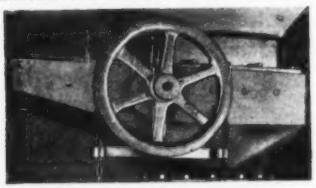
"VAC-VEYOR" SYSTEM

In this system, ashes, siftings, soot and dust are conveyed by pipe from the ash pits, dust collectors, stack, etc., to an ash receiver and separator at the top side of a silo—by means of a vacuum. One man operates the system, keeping your plant cleaner with less labor.



COAL HANDLING

Coal arrives by rail, is dumped into hopper, raised by bucket elevator and discharged either into bunker for immediate use or down chute to yard storage. One operator controls all equipment.



ROLLER BEARING GATE

Incorporating double rack and pinion for granular or powdered materials, these drip-proof self-cleaning gates will not corrode, bend or warp. Material cannot collect in back of gates—these ball bearing gates operate manually or electrically without strain or ramming.

AUTOMATIC WEIGHING SCALE

Accurately weighs coal and similar materials from 1 to 60 tons per hour. Vibrating feeder plate eliminates belts, pulleys and motors. Scale is totally enclosed, dustproof and quiet.

DRAG SCRAPER SYSTEM

Coal is dug evenly with minimum power consumption. Tail blocks can be slung between posts and moved by hand, mechanically moved on I-beam track by tail block car, or suspended from aerial bridge system. One man can operate entire system by remote control.

ASH HOPPERS AND GATES

Steel plate ash hoppers are low cost, rigid, unbreakable, watertight and, when lined with refractory material, resist temperature and erosion. Ash gates are designed for use on stoker and pulverizer ash hoppers where water sealing and draining is essential.

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Designers Manufacturers Erectors BULK MATERIAL HANDLING SYSTEM

ELECTRONICS

(*Continued from page 120*)

cation of on-off control. Here a sensitive contact D, such as on a contact-making voltmeter, is used to close a relay coil circuit. If the contact were used directly to actuate the relay, arcing would soon destroy it. By using a triode in the circuit the current carried by the contact can be made almost infinitesimal by connecting a very high resistance in series with the grid.

In Fig. 4, battery C connects to the grid through resistor R, which we can assume to be 1,000,000 ohms (1 megohm), even though it may be much higher. Resistors of several millions ohms (megohms) are frequently used in amplifier circuit.

Battery C put a minus bias on the grid equal to its volts, which we can assume to be 10. This is applied from — on the battery through resistor R, from the grid to the cathode, to the + battery terminal. Since the circuit is open from grid to cathode no current flows through the resistor. Therefore, there is no voltage drop across it and the grid has a minus bias of 10 v. This we will assume is sufficient to stop current flow through the tube. Under these conditions the tube acts as an open switch in the relay coil circuit.

When contact D closes, Fig. 5, it connects resistor R across the battery and the grid to the cathode to reduce grid voltage to zero, and permit maximum current flow through the tube. Battery C circuit is through resistor R, contact D and to + battery terminal. Current flowing through resistor R equals volts divided by ohms.

Current Flow Through Tube. We assumed a battery voltage of 10 and R to have 1,000,000 ohms, then the current in amperes equals $10 \div 1{,}000{,}000 = 0.00001$ or one one-hundred-thousandth of an ampere. This current, which D must break, is so small that the contact will not be injured, even though it may be very small and sensitive.

When grid bias drops to zero the tube conducts from battery B — terminal through the tube, the relay coil back to + on the battery. Energizing the relay's coil closes its contact, which in turn may close the coil circuit on the line contactor of, say, a 50-hp motor. Thus we have made it possible for a very light contact D to start and stop a large motor. In other words, we have amplified through the tube and relay, the small fraction of a watt expended in resistor R to operate a 50-hp motor, requiring nearly 50-kw power.

In Fig. 5, the tube conducts when contact D closes. By using the connections, Fig. 6, the tube conducts when contact D is open. Battery C is disconnected from the grid so its bias is

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zero and the tube conducts to close the relay. Current flow through the relay coil is the same as in Fig. 5.

If contact D is closed, full battery voltage is applied across the grid to the cathode. Since the grid connects to the — terminal of the battery it has a minus bias to block the tube. In this diagram, sensitive contact D has to break only the few millionths of an ampere flowing through resistor R.

Resistors Replace Batteries. In Fig. 7 resistors replace batteries, Fig. 4, to permit the relay to operate from a 230-v circuit. Resistors R_1 and R_2 must be selected to supply correct cathode current and the required voltage to operate the relay. The necessary grid bias voltage for control of the relay is obtained by a tap off resistor R_3.

With contact D open, the circuits are from — line terminal through resistor R_3, the cathode heater and R_2 to + line terminal. Current in this circuit heats the cathode to supply the necessary electrons for relay operation. Grid potential comes from tap T on resistor R_3 through R to the grid and cathode, R_2 and to the + line. This puts a minus bias on the grid equal to the volts' drop from tap T to the cathode, to block the tube and hold the relay open.

When contact D closes, Fig. 8, it connects the grid to the cathode so both are at the same potential. The tube can now conduct as indicated to close the relay. This circuit is from the — line through R_3 to T. Here the circuit divides and goes through R and the right-hand half of R_3, in parallel to the cathode, through the tube and relay coil to + line. This applies the volts across the cathode heater and resistor R_2 to the tube and relay coil in series to close the relay.

The relay coil current through R_3 tends to increase the volts' drop across it and reduce the cathode-heater current. Relay-coil current is small compared to cathode-heater current so it does not cause the volts' drop that might be expected at first thought. Connecting resistor R, in parallel with the right-hand half of R_3, reduces the resistance of that part of the circuit and consequently the voltage drop from T to the cathode. By a proper selection of these resistors, volts' drop from — line to the cathode and cathode current can be held practically constant.

Phototube Replaces Contact. Fig. 9 shows how contact D, Fig. 6, may be replaced by a phototube P. As long as light shines on the tube's cathode it conducts and current flows from — on battery C, to the cathode and anode of tube P, through resistor R back to + on the battery. If a connection existed between the grid and cathode of tube E, current could also flow through them to + on battery C. But since they are

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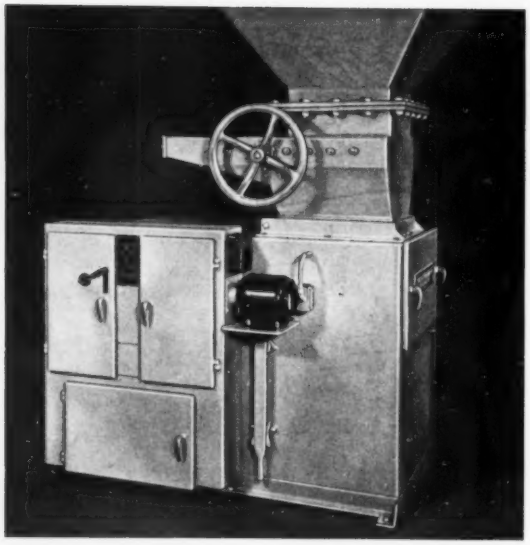

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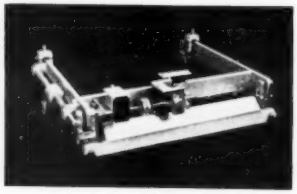

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insulated from each other, voltage drop across resistor R puts a minus bias on the grid, which we will assume blocks tube E.

If some opaque object comes into the light beam, as in Fig. 10, tube P no longer conducts but acts as an open switch. Then, as there is no current flow through resistor R, minus bias is removed from the grid and tube E conducts. The circuit for the relay coil is the same as in Fig. 6, as indicated by arrows.

The light beam can be interrupted in any one of several ways. The light might be set to shine at a certain level across a conveyor onto the phototube. Boxes that can pass below the light beam move along the conveyor without interference. When a high box comes along it interrupts the light beam. This causes the relay to be energized which, in turn, actuates a mechanism to shunt the high box onto another conveyor.

The relay can be replaced by the coil of an electric counter. Then each time an object passes along the conveyor it interrupts the light beam to actuate the counter.

Control of Light Beam. Instead of breaking the light beam to actuate the relay, light on the tube's cathode can be gradually changed. For example, the light beam may be directed from one side of boiler's breeching across the gas stream onto phototube on the other side. When the stack gases are dark they interrupt the light beam to permit the triode to conduct and energize the relay. When the relay contacts close they can complete a circuit to sound an alarm and light a red lamp to call attention to the smoke. This is the principle of smoke indicators, which we will study later.

How a relay is closed by a phototube when light shines on the tube and opens when the tube is dark was explained in Fig. 12 and 13, p 104, September 1948, POWER. A phototube could be substituted for switch D in Fig. 4. Then by making the resistance of R very high (several megohms) grid bias can be reduced to a low value, but not to zero. There will always be a minus potential on the grid equal to the volts' drop across the photo tube. This might be objectionable in some applications and not in others.

The electronic-relay circuits in this article are used chiefly to demonstrate principles of operation rather than to show commercial circuits. Most electronic relays operate on ac circuits, as will be discussed in the next article.

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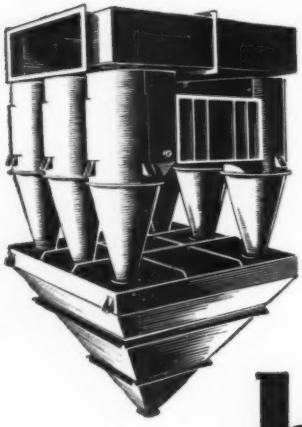

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Plant Problems

(*Continued from page* 128)

Too Much Air in Water Line

BC's SKETCH DOESN'T SHOW any valves in line from spray pond to condenser; there should be at least one. Normally spray ponds are quite large and shallow. If pond is narrow, water level may fluctuate. Makeup water may be changing the suction head. Following should be known for a complete analysis. Is the circulating pump motor-driven? Is plant electrical load too heavy before turbine is on the bus? How long does it take to bring turbine to speed?

Condenser does not enter the picture since any fouled or ruptured tubes would cause a decrease in circulating-water discharge pressure. *BC's* answer lies either in fluctuation of pond level or in the pump.

Turbine speed would have a bearing on the water pressure only if the pump were motor driven and the motor picked up speed because of increased frequency with turbine-generator on the bus.

If pump drive is all right, initial low pressure could be caused by too much air in water on starting. Turbine-speed pickup time may coincide with time it takes to purge system of air. This can be checked by rolling the turbine longer at lower speed or by bringing it up faster and checking pressure.

F J HERZINS *Tyrone, Pa.*

Is Frequency Increasing?

ONE OR BOTH of the following factors may cause *BC's* pressure increase:

1. Increase in pump speed because of supply to pump motor. Discharge pressure varies as square of speed.

2. Increase in quantity of water pumped caused by changing from throttling to non-throttling on suction side of pump.

Expanding condenser tubes or otherwise reducing pressure drop through the condenser circuit would raise suction pressure and cause an increase in pump-discharge pressure.

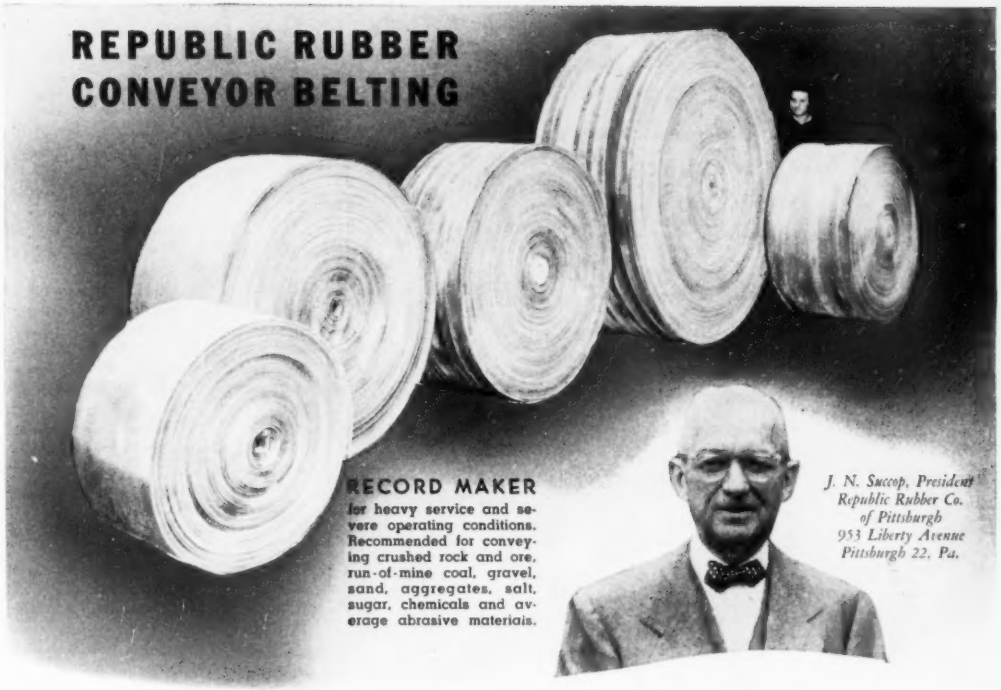
W H CHANAULT *Atlanta, Ga.*

Water Boxes May Leak

BC's HOOKUP IS UNUSUAL because the condenser water boxes are at a partial vacuum rather than positive pressure. Air is probably leaking into the water boxes because of bad gasket or a loose flange either on the water boxes or where the circulating-water lines connect.

It is quite possible that condenser expansion causes the leak to take up and the pump to circulate more water, thereby increasing the discharge pressure.

E W MCKNIGHT *Ninety Six, S. C.*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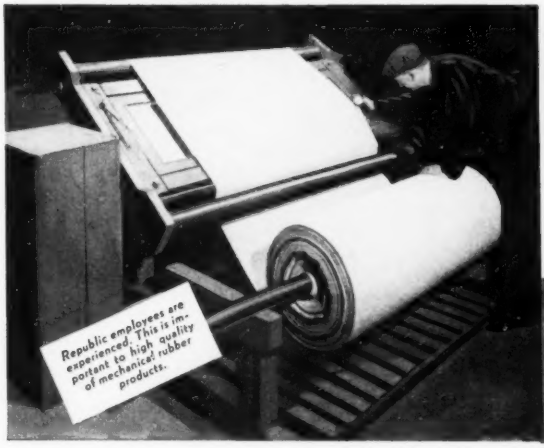

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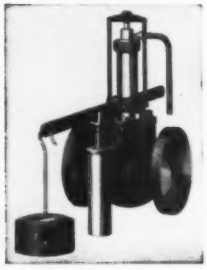
No. 14

(Right) A direct connected, spring loaded pressure reducing valve designed for general industrial service on steam, air, gas, water, or oil. Features parabolic balanced disc construction with full port area. Immune to high pressure fluctuations. Control pressure to diaphragm chamber from reduced pressure line. Sizes ½" to 14". Screwed or flanged connections. Bronze, monel, or stainless steel trim. For pressures to 400 p.s.i.; any reduced pressure up to 200 p.s.i.



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Technical Briefs

(*Continued from page* 132)

after comparison with new steam-plant capacity and new water-power development costs. There was available in the present Buchanan Dam plant, intake works and a short piece of penstock for a third unit. Pump installation was designed to use the same penstock as the new third unit. Installed cost of both elements will not exceed cost of equivalent steam capacity.

Inks Lake, forming the tail-water of Buchanan Dam, assures abundant water supply for pump operation.

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No appreciable increase in personnel is needed to operate the new installations.

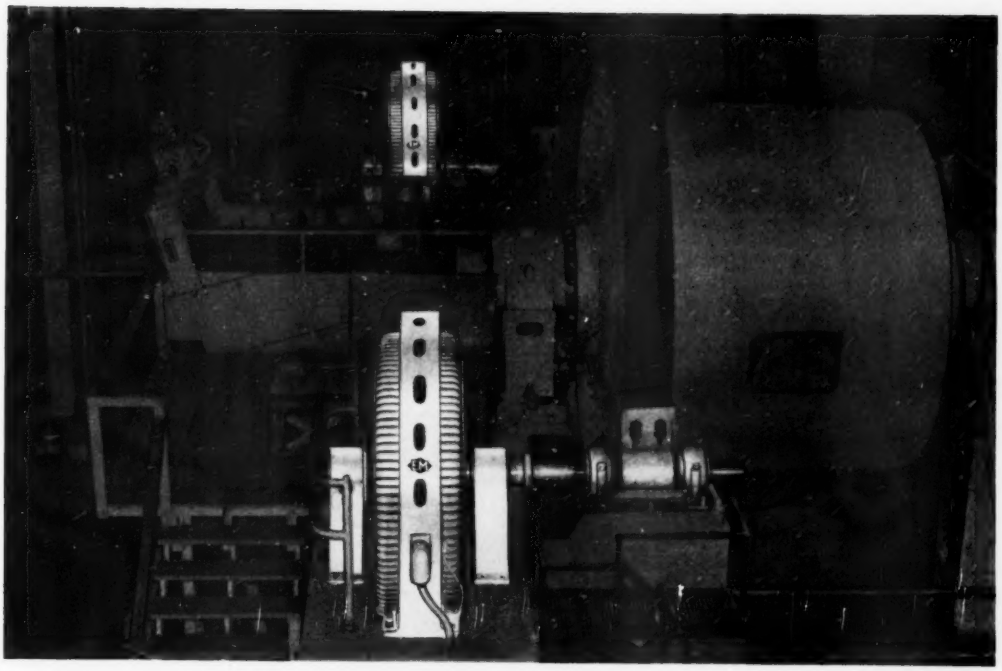
Sufficient river flow is anticipated during three years out of every ten for three generating-unit operation with curtailed pump utilization.

After the decision had been made it developed that delivery promises on hydro equipment were more favorable than for steam.

The new hydro unit will be a 12,500-kva vertical waterwheel generator capable of producing 14,000 kw under full head. The 17,300-hp turbine will have a single runner of the Francis type with plate-steel spiral casing. *AIEE Paper. No number.*

SOFT-RUBBER BEARINGS—DESIGN FEATURES AND METHODS OF APPLICATION TO CONDITIONS OF WATER LUBRICATION, *by A Bednar, vice-president, Lucian Q Moffitt, Inc, Akron, Ohio.* Soft-rubber compositions, when properly prepared, have shown many outstanding properties as material for water-lubricated bearings. This is true even to a greater degree of some of the rubber-like synthetic compounds developed in recent years. Ability of these elastic substances to resist abrasion and impact is daily demonstrated by the almost phenomenal performance of modern automobile tires. The low-friction characteristic that they possess when wet is also commonly illustrated by the tire's behavior when it slides and spins on wet car tracks. This illustration is even more impressive when we remember that every effort is made in the tire design to prevent sliding.

Bearings of soft-rubber or rubber-like compounds utilize these properties and others to provide economies and operating efficiencies under conditions of water lubrication. Such bearings have continually increased in use since they were introduced 25 years ago. This paper outlines some design and



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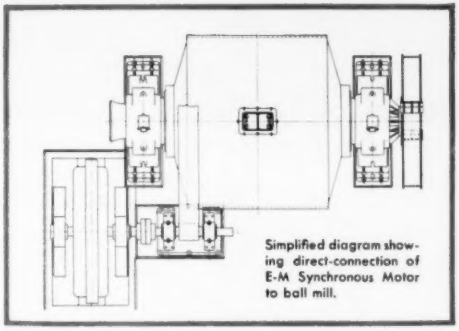

Simplified diagram showing direct-connection of E-M Synchronous Motor to ball mill.

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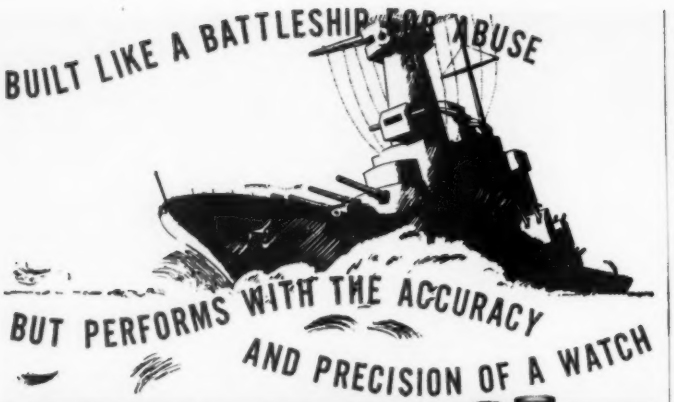

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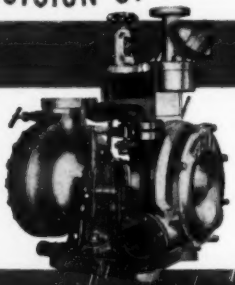

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165

construction features in common use, and their application to present-day industrial services.

Usual service for such bearings includes stern tube and strut bearings of boats and sea-going ships, as well as rudder shaft or pintle bearings on these vessels; guide bearings on hydraulic turbines, where shaft diameters often exceed 30 in.; bearings in deep-well turbines and pumps of other classes, such as power-plant circulating water, dredging pumps, and others handling water or other liquids. These bearings perform exceptionally well on cutter shafts of hydraulic suction dredges where impact and abrasive conditions are particularly severe. Sand washers, classifiers and agitators used in various industrial processes are other common applications. In chemicals, which are destructive to ordinary bearing materials, rubber and synthetic rubber offer convenient solutions to otherwise difficult bearing problems. They permit a longer operating life.

Among the most important factors outside the bearings that influence performance are the characteristics of the journal or shaft. Although abrasive particles suspended in the lubricating liquid have comparatively little effect on the rubber lining, the degree of roughness of the shaft surface is of major importance in rate of wear and friction losses in the bearings. Smooth, noncorrodible high-quality shafts are, therefore, essential.

Commercial bronze shafts processed for service as shafting, not rods, and monel metal, are satisfactory for most waters, including sea water. On large shafts where wearing sleeves are provided at the bearing points, service experience indicates that the most acceptable general-purpose materials are the Navy specification bronzes, composition "G" or "M," particularly when centrifugally cast. Under some severe abrasive conditions, as on dredge cutter shafts, centrifugally cast monel-metal sleeves have proved economical. In river or lake waters, limited experience with sleeves fabricated from stainless-steel plate shows promising results. Metalized surfaces of stainless steel, monel metal, or bronze, on small or medium-sized shafts, have been found satisfactory in some fresh-water operations. But, substantial variations in performance of these metalized surfaces have been observed, apparently due to the various ways they are applied. More uniform and perhaps better methods seem to be needed. Chrome-plated surfaces have shown outstanding performance, even in abnormally abrasive uses, but, here again, the method of applying the chrome plating is extremely important. *ASME Paper. No copies are available.*

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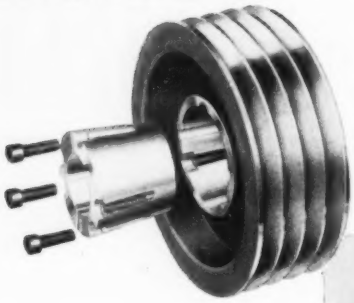

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MARINE PESTS

(*Continued from page 94*)

plete a reversal. This causes a recirculation of warm water to the condensers for about 12 minutes. The warmer water does not affect the ability of the units to carry full load.

As Fig. 8 shows, mussels die in about one hour when water temperature rises above 100 F. To achieve this temperature the gates have been operated as follows whenever ocean water exceeds 60 F. Temperature of the intake line rises 19 F when reversed, if the station carries full load. To increase this temperature to a lethal value of 102 F, one of the gates is opened to recirculate enough water to the condensers until this discharge temperature is produced. This level is maintained four hours before stopping the recirculation and returning cooling-water temperatures to normal. Intervals between reversals have been varied between ten days and three weeks. As experience accumulates it may be possible to increase this to a longer interval.

Monthly inspections by a diver during the first summer's operation have shown both pipes to be completely free of marine fouling. Effectiveness of killing by heat has been shown by inspections of several small vertical pumps supplying station salt-water service, Fig. 5. The suction water for these pumps does not receive the heat treatment. External columns of these pumps had layers of mussels 6 to 8 in. thick. Similar accumulations would undoubtedly have collected in the tunnels without heating.

On an annual basis, it is estimated that the heat treatment costs about $800 for the two 66,000-kw turbine units now installed. It is estimated that the same effective job with chlorine would cost about $50,000. While some capital expenditure was needed to provide flow reversal, it is judged that fixed charges on these units are considerably below the probable annual chlorine expense.

REFERENCES

This article was based on the following four ASME papers:

No. 49-S-15, "Some Biological Fundamentals of Marine Fouling," by W F Clapp.

No. 49-S-12, "Control of Marine Fouling in Sea Water Conduits and Cooling Water Systems Including Exploratory Tests on Killing Shelled Mussels," by H E White.

No. 49-S-20, "Project Study for the Mitigation of Marine Fouling," by I A Patten.

No. 49-S-13, "Control of Marine Fouling by Temperature at Redondo Steam Station of the Southern California Edison Co," by W L Chadwick, F S Clark and D L Fox.

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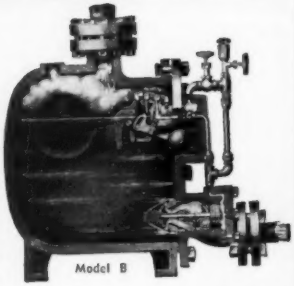
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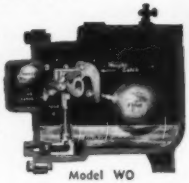
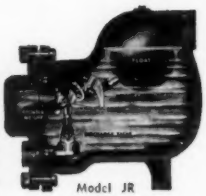

Model WD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Look for this extra on the motors you buy; it means lower maintenance costs, less time lost for motor replacement.

GENERAL ELECTRIC

SLIDE RULE

(*Continued from page* 115)

is 14. Use that 103 for wires No. 10 through 19, and 104 for wires larger than No. 10. Use 102 for wires between 20 and 40.

Next number to keep in mind is 302. Find that on the *A* scale and when you do, you'll read 12.4 on the *B* scale, Fig. 3. This is the weight in lb per 1000 ft. The last step is to go back to 103 on the *B* scale, and opposite it on the *A* scale find 2.52, Fig. 4. This last figure is the resistance in ohms per 1000 ft at 70 F.

Another good rule to place in your mental file is that No. 10 wire has a resistance of nearly 1 ohm per 1000 ft and a diameter of 101 mils. The weight of 1000 ft of No. 10 is about 31 lb.

Take another case where we know the wire size to be No. 20 B and S. That 20 corresponds to 10 on the log scale of the slip stick. Then working back over our tracks we find the diameter is 32 mils on the *C* scale, area is 1025 cm on the *B* scale, 10 ohms on the *A* scale. Opposite 302 on the *A* scale we find 3.1 on *B*, the weight per 1000 ft.

Large Wires. For sizes larger than No. 10 the slide is moved to the left until we come to *O* on the log scale. This corresponds to 1/0 B and S. Now for wires larger than 1/0 use the right index, and call 10 on the log scale 1/0. Then 95 will equal 2/0, 9 on the log scale 3/0, and 85 is 4/0.

The same general idea holds true for cables greater than 4/0. For instance, take a 500,000-cm cable. Set 5 on the B scale in line with the right index of *A*. Then set the hairline of the indicator to 104 on *B*. On *A* you'll find 0.0207 ohms per 1000 ft, and opposite 302 on *A* read 1510 on *B*; that's the weight per 1000 ft.

Of course, results with this method do not approach the accuracy of a wire table. But they are close enough for all practical purposes.

FUEL PRICES

(*Continued from page* 101)

we see again that while No. 5 oil has always been at some disadvantage with respect to coal, No. 6 fuel now shows a slight edge and has been cheaper than coal at times in the past.

The conclusions to be drawn from these data are left to the reader, since the intent of this study was merely to analyze existing information.

Editor's note: The following comments represent our opinions as to conclusions that may be drawn from the author's figures. They may prove helpful in your own interpretation of them.

Study fuel costs at long range...

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In planning the operation of your power plant, study the value of bituminous. Check production cost at the mines. Look at delivered cost of Btu's. Study how carefully the coal you order is sized and cleaned so that waste is avoided. Check availability of continuous supply in normal times and in emergencies. Find out if reserves are extensive enough to assure future supply.

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What Figures Reveal. The most obvious fact revealed by these figures is that while fuel prices in general have risen, along with the general price level, the price of oil tends to vary more widely and rapidly than that of coal. This reflects basic differences in the factors influencing prices. For coal, demand has grown at a relatively steady rate during the past ten years but has just shown some signs of slackening. Perhaps the most important factor in price has been production cost. Here higher wages have tended to offset gains resulting from improved mining methods.

For oil, the important fact is that the heavy fractions remain essentially a by-product of refining. Production tends to be geared to demand for gasoline and light distillate oils, such as are used for home heating. When demand for the byproduct fuels (No. 6 in particular) is high, they command a good price. Since the supply is relatively inflexible, when demand falls off price of fuel oil drops as it did early this year. Thus fuel-oil prices are apt to be more sensitive to demand than coal prices and movements are more rapid and wider.

The behavior of fuel-oil prices after wartime restrictions went off illustrates the way these factors work. During the short-supply period, prices soared, and oil's competitive position suffered. Fig. 5, 6. Determined to avoid shortage conditions in the winter of 1948-49, the oil industry geared for high production of all fuel oils. When the weather proved exceptionally mild and demand did not materialize as expected, the price had to come down, and did.

It can be seen that forecasting fuel price trends in advance is extremely difficult, if not impossible. The commonsense solution seems to be to provide as much fuel flexibility in plant design as conditions permit. Then it becomes possible to take advantage of price swings in the fuel market, as they occur.

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(Continued on page 210)

Fact File on Preheat

No. 3

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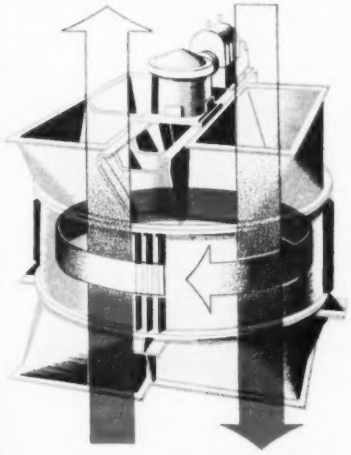

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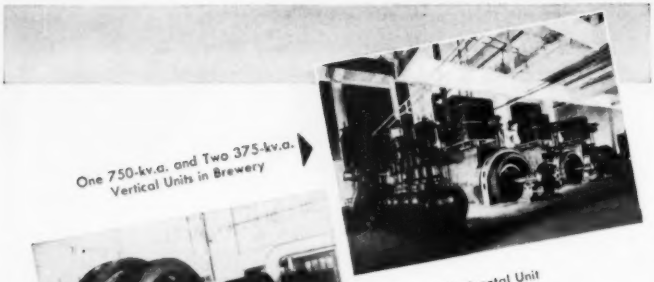
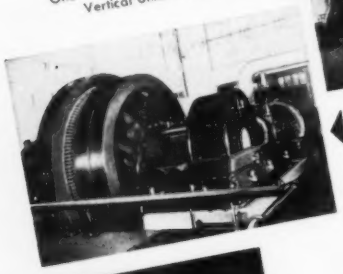


One 750-kv.a. and Two 375-kv.a. Vertical Units in Brewery

1000-kv.a. Horizontal Unit in Furniture Factory



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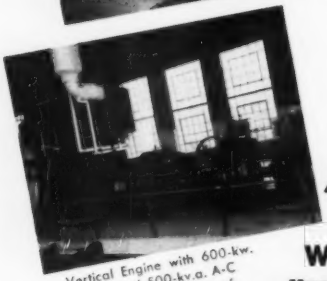
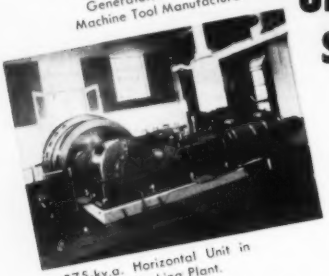


Vertical Engine with 600-kw. D-C and 500-kv.a. A-C Generators in Plant of Machine Tool Manufacturer



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(Continued from page 146)

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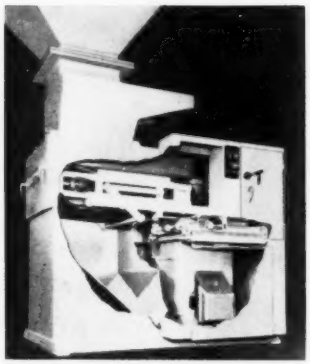

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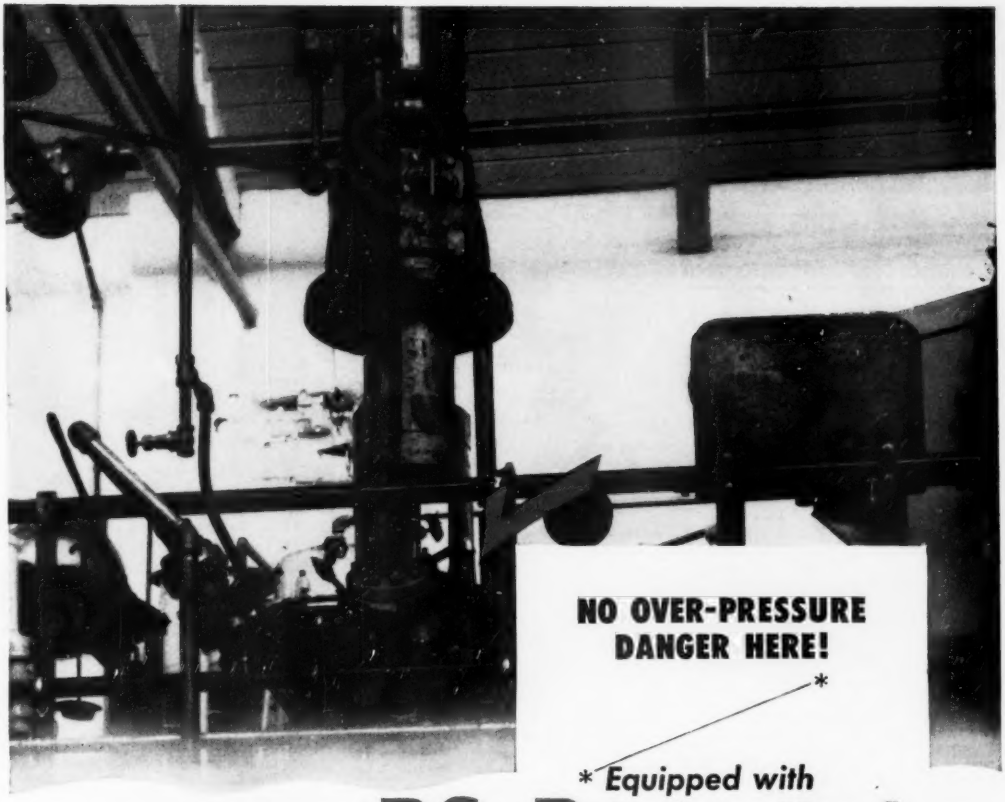

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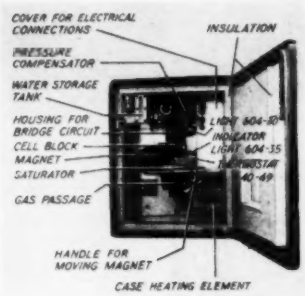


P788 • OXYGEN METER—*Magno-Therm* oxygen meter operates on paramagnetic property of oxygen. It continuously analyzes, indicates and records percentage of oxygen in boiler flue gas and industrial gases. Measurement is compensated for ambient temperature, barometric pressure and variable moisture content of gas sample.

In operation, gas is passed through a cell block in which there are two cells containing heated resistors. The sample gas diffuses into both cells. A strong magnetic field from a permanent magnet is directed across one resistor in measuring cell. The oxygen-bearing gas is attracted into the magnetic field and becomes heated by the hot resistor. The oxygen loses its magnetism as it becomes heated and is forced out of magnetic field by the cooler, more magnetic oxygen. Cooling effect on heated resistor is proportional to magnetism of gas entering cell. This changes its electrical resistance and increases current flow through it. Change in current flow is compared with current flow in the comparison cell resistor and difference in resistance is measured by the Hays *Acratron* electronic recorder, calibrated to read in percent oxygen.
Hays Corp, Michigan City, Ind.

P779 • ELECTRIC HEATER—One-piece, finned cast aluminum, natural convection, heating element consists of nickel-chromium resistor wire, insulated and sheathed in seamless metal tubing. Heater mounts to a wall and operates under thermostatic control through a contactor. Explosionproof heater is available in three models, 2000, 4000 and 6000 watts.
Electromode Corp, 45 Crouch St, Rochester 3, N. Y.

P769 • COMMUNICATION SYSTEM—Basic pair-phone system consists of two standard size, wall mounting, self-powered telephones. They do not need batteries nor power source for either talking or ringing. This 2-phone system is effective up to 20 miles.

The basic 2-phone system has been extended to include a master phone system

BELCO FULLY AUTOMATIC WATER SOFTENER INSTALLED IN MIDWESTERN MUNICIPALITY

The most recent advancement in automatic water softener control is illustrated above in the Belco motor operated single control valve. This plant produces 1.25 mgd of soft water with exceptionally low operating cost and minimum maintenance.

The unique features of the Belco Multiport Valve are that rubbing rotors are completely eliminated, pressure losses are reduced to a minimum and the high mechanical advantage makes it feasible to use a low H. P. electric motor for valve functions.

The saving in pumping and electrical costs for operating the multiport valve as well as the low chemical cost utilizing Belcolite Resins have resulted in a far more economical plant.

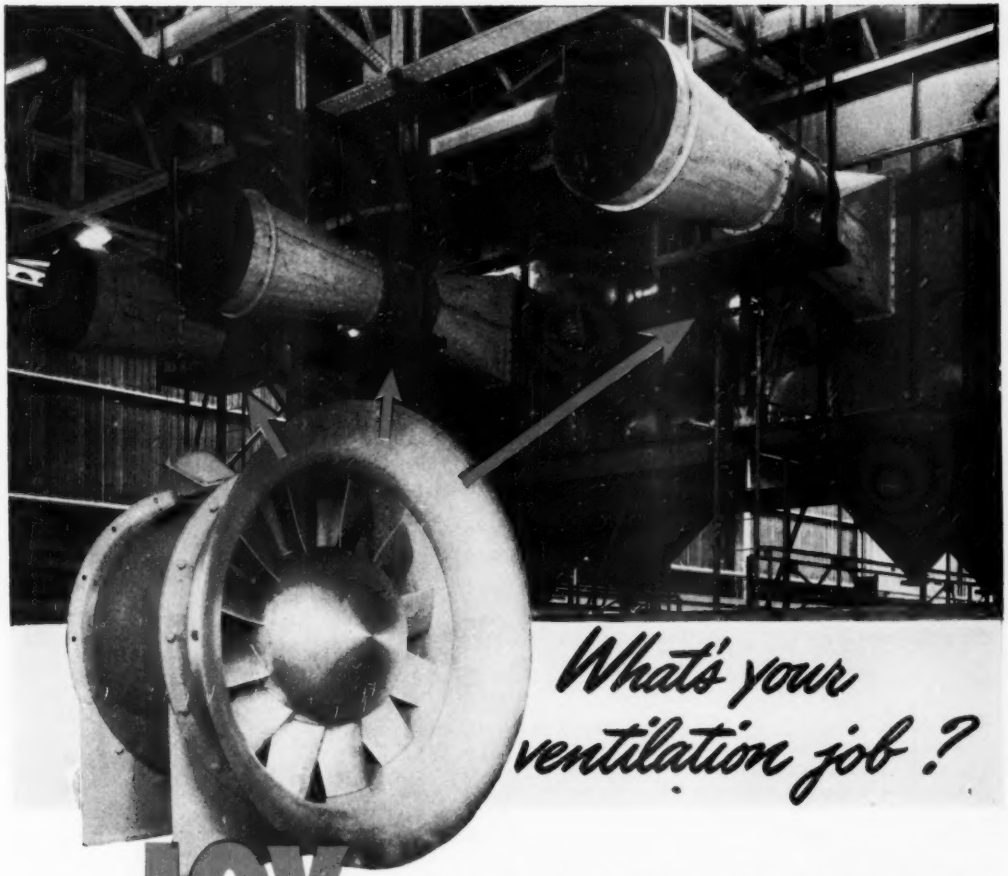
MODERNIZATION RESULTS IN LARGE OPERATING SAVINGS

The Belco automatic valve and Belcolite Resins can be applied to existing water softening installations to lower maintenance and chemical costs to such a degree that in most cases they will repay the original expense in a few months.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
56 Iowa Avenue **Paterson 3, N. J.**
Midwest: Deady Chemical Co., Kansas City, Mo.
South: Gulf Engineering Co., Inc., New Orleans, La.
Florida Industrial Equip. Distr., Miami, Fla.
Southwest: Watermasters Inc., Houston, Texas
Pacific: Deady Chemical Company, Los Angeles, Cal.

Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES



What's your ventilation job?

JOY AXIVANE* FANS

WILL DO IT MORE EFFICIENTLY AND MORE ECONOMICALLY!

Write for Bulletin, or *Consult a Joy Engineer*

From every possible angle, JOY Series 1000 AXIVANE Fans will give you a better, lower-cost job. Their inline, vane-axial design is lighter and more compact; and they operate more quietly, require less power and space, and save greatly on installation time and costs. What's more, you get the extra flexibility of adjustable blades—an *exclusive* JOY feature—permitting easy and quick on-the-job regulation of pressure or volume over a wide operating range, with positive protection against motor over-load. ● Whatever your job is, JOY AXIVANE Fans can show you advantages—let us work with you.

*Reg. U.S. Pat. Off.

WBD 12356

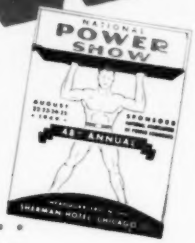
JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

*Everybody's going to the

Power Show



CHICAGO
AUGUST 22 thru 25

Show them . . . *Sell them* . . .
with a Power Show exhibit

It's your only chance this year to reach thousands of your important customers and prospects . . . at the one big annual meeting of the men who specify and buy steam and power generation, compressed air and materials handling equipment and supplies . . . the 48th *National Power Show* at the Hotel Sherman, Chicago, August 22 thru 25. Sponsored by the National Association of Power Engineers . . . held in conjunction with the 66th Annual Convention of this 15,000-member national organization.

Ask about extra FREE space for working models and demonstrator booths.

***Everybody in the power field . . .**

- key personnel from selected industries . . . by your own special invitation to management, purchasing, and engineering executives, maintenance and operating engineers
- members of local and national engineering clubs, associations, and societies
- faculties and students of engineering schools, colleges and universities

For exhibit space and attendance information *write, wire, or telephone . . .*

A. F. THOMPSON, National Secretary
Suite 1736, 176 West Adams Street, Chicago 3, Illinois
***Telephone* FRanklin 2-0836**

These famous names in the power field are among the exhibitors who made early reservations for space at the 48th Annual Power Show

American Structural Products Co.
Apex Engineering Co.
* Armstrong Machine Works
* Babcock & Wilcox Co.
Barrett-Christie Co.
Brooks Boiler Treatment Co
Bros Brothers Boiler Co.
* Chicago Faucet Co.
Chicago Metal Hose Corp.
* Combustion-Engineering, Superheater, Inc.
Condenser Service & Engineering Co.
* Corbett, Geo. E., Boiler & Tank Co., Inc.
* Davis Regulator Co.
* Dearborn Chemical Co.
DeZurick Shower Co.
Dowell, Inc.
Electric Auto-Lite Co.
Fairbanks, Morse & Co.
Flynn & Emrich Co.
* Garlock Packing Co.
Graton & Knight Co.
* Green Fire Brick Co.
Henricksen, C. O. Co.
Hills-McCanna Co.
Insto-Gas Corporation
Jefferson Union Co.
Kapsa, W. A. Co.
Kramer, Fred C. & Co.
* Lammert & Mann Co.
Livingston Engineering Co.
Lowden & Company
Louis Allis Co., The
* Lunkenheimer Co.
McDonnell-Miller Co.
McNeill Engineering Co.
* Mason-Neilan Regulator Co.
Metalock Repair Service, Inc.
* National Aluminate Corp.
* Nevins, W. P. Co.
* Otis Elevator Co.
Perfex Corporation
Perolin Co.
Pilbrico Jointless Firebrick Co.
Power-Operating Engineer
* Ramtite Co. Div. of S. Obermayer Co.
Roebling's, J. A. Sons Co.
Schaub Engineering Co.
Sexauer Manufacturing Co.
* Shell Oil Co.
* Standard Oil Co. (Indiana)
Strong, Carlisle & Hammond Co.
Vickers, Inc.
* Walworth Co.
Williams Bros. & Miller, Inc.
Wright Chemical Co.

***These companies have exhibited continuously for 10 or more years**

consisting of one master phone station and up to eleven outlying substations. A second refinement is the production of a multi-selective ringing and talking system. This allows up to twelve master phone stations, providing for selective ringing of any one or all other master phones on the system.

Wheeler Insulated Wire Co, 150 E Aurora St, Waterbury 91, Conn.

P772 • IMPACT WRENCH—Size 577 impact wrench handles large studs, bolts, nuts and cap screws from 1¼ up to 2 in. Wrench operates on rotary impact principle by which motor torque is converted into 1000 rotary impact blows per minute.

Wrench is powerful enough for heavy work. It weighs only 72 lb because housing is made mostly of magnesium. Wrench is 24½ in. long and operates at 535 to 565 rpm.

Ingersoll-Rand Co, 11 Broadway, New York, N. Y.

P783 • POCKET MAGNET—Probe is suitable for removing steel or iron particles from those areas where they would do harm to electrical instruments or delicate mechanism. Point of magnet can be extended or retracted from polished Bakelite case by turning end-knob.

Probe is handy for use in first-aid stations to remove steel splinters from eyes or skin. Nurse or doctor can adjust strength of magnet for proper extraction to reduce pain or rupture of tissues.

General Scientific Equipment Co, 2700 W Huntingdon St, Philadelphia 32, Pa.

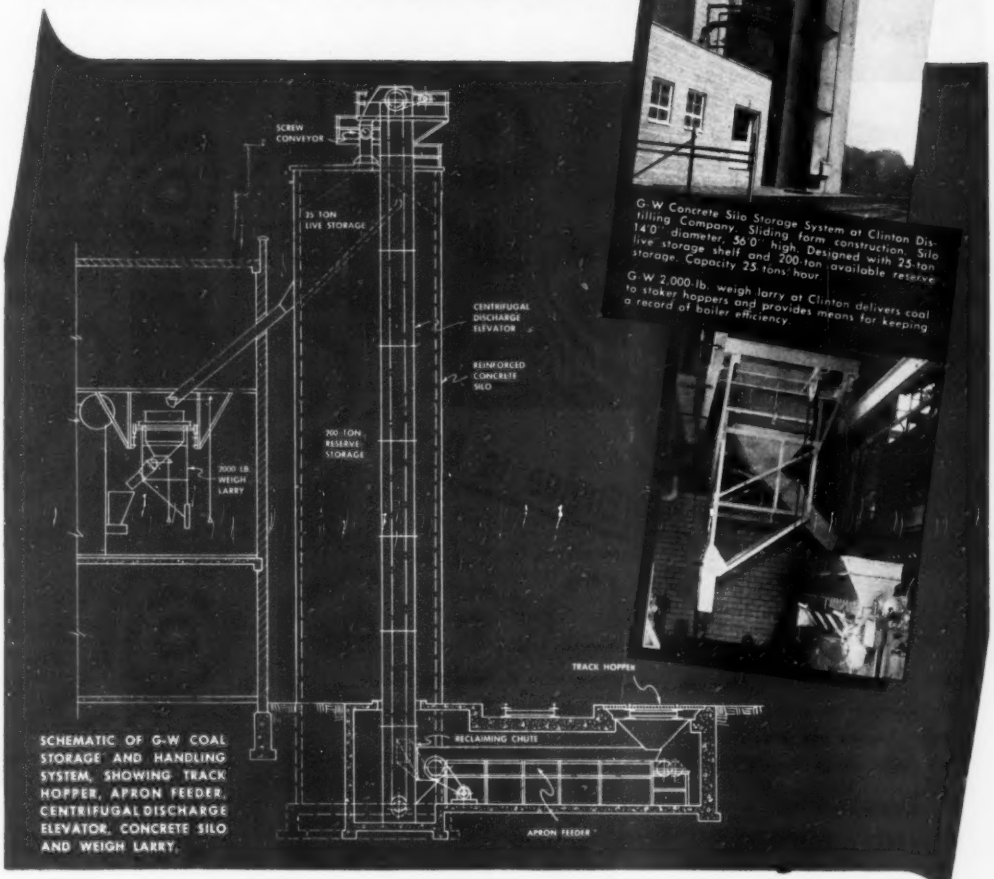
P778 • AIR CIRCULATOR—An induced-draft air circulator put in the bonnet of coal-, gas-, or oil-fired hot-air furnaces draws incoming furnace air over hot crown of the firebox before circulating it to the air ducts. *Magic-Wheel* moves an air volume of 250 cfm at 70 F. Fan starts at 150 F and shuts off when bonnet temperature drops 10% below this setting.

Bazley & Schumaker Engrg Co, Colorado Springs, Colo.

P773 • PORTABLE ELEVATORS—Hand-operated elevators have capacities of 500, 1000 and 2000 lb. These three general-purpose elevators have been designed and engineered for safe, fast and economical loading and stacking.

Their maneuverability makes them well

Your Cost of HANDLING Coal Depends On How You STORE It



SCHEMATIC OF G-W COAL STORAGE AND HANDLING SYSTEM, SHOWING TRACK HOPPER, APRON FEEDER, CENTRIFUGAL DISCHARGE ELEVATOR, CONCRETE SILO AND WEIGH LARRY.

G-W Concrete Silo Storage System at Clinton Distilling Company. Sliding form construction. Silo 140'-diameter, 56.0' high. Designed with 25-ton live storage shelf and 200-ton available reserve storage. Capacity 25 tons/hour.

G-W 2,000-lb. weigh larry at Clinton delivers coal to stoker hoppers and provides means for keeping a record of boiler efficiency.

The problems of automatic coal and ash handling in steam generating plants fall into the general design pattern of one of four basic types of G-W coal storage systems.

The system illustrated is an example of this kind of simplified engineering. Conditions at Clinton Distilling Co., Clinton, Iowa, called for the reinforced concrete type silo as best suited to their location, available space, and allowable initial cost per ton of storage. To complete the installation, G-W installed track hopper, apron feeder, centrifugal discharge elevator, and a 2,000-lb. weigh larry.

One of the four basic G-W Storage Systems with proper handling equipment, will be the right one for *your* plant conditions—Concrete Silo, Vitrified Tile Silo, Cylindrical Steel Tank, or Suspended Steel Bunker. Every complete G-W Coal and Ash Handling System is fabricated and installed under *one* contract, *one* responsibility, *one* delivery schedule.

Gifford-Wood's 135 years of materials handling experience is available without obligation to consultants, engineers and plant owners. If coal and ash handling is your problem, get in touch with G-W today.

5517

GIFFORD-WOOD CO.

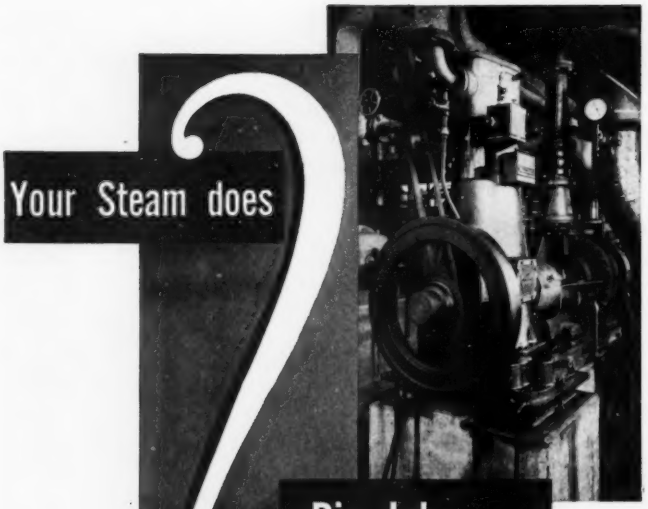
SINCE 1814

G-W HANDLES IT . . .
faster • easier • cheaper

NEW YORK 17
420 LEXINGTON AVENUE

Factory:
Hudson, N. Y.

CHICAGO 6
565 W. WASHINGTON ST.



With proper plant heat balance your steam may do two big jobs. If you generate steam for processing or heating a Troy-Engberg Steam Engine can produce By-Product Power at a very low cost. The same steam then yields power as well as heat units!

It's the simplest story in the plant. Steam is first passed through the engine — driving pumps, stokers, compressors, blowers or generators. Then the exhaust, with most of the original heat units still intact, is used for processing or heating. And for dependability nothing beats the standard counterflow steam engine . . . no interruptions from power failure.

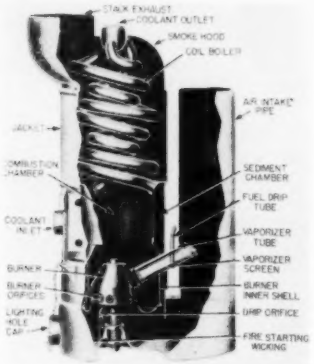
TROY ENGINE & MACHINE COMPANY
(Established 1870)
2500 Railroad Avenue **Troy, Pennsylvania**

TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

suited for such additional uses as die handling, servicing balconies, overhead repairs and motor-truck loading. Over-all height 8 ft, lift 6 ft, platform 24x30 in. Elevators include all-welded construction, cut spur-gear reduction, caster steer and floor lock.
Barrett-Cravens Co, 4609 S Western Blvd, Chicago 9, Ill.

P775 • SILICONE INSULATION—Designated as silicone resin No. 9989-1, it is designed for general application in impregnating spun glass and asbestos wire covering, in addition to binding coils, windings and other motor, generator and transformer parts. New silicone insulating resin will allow electrical equipment to operate at temperatures as high as 180 C.

This insulating resin has a high dielectric strength as well as good heat and water resistive characteristics. Silicone resin may be cured in conventional manner at baking temperatures ranging to 250 C; it dries tack-free in less than 30 min at relatively low temperature.
General Electric Co, Pittsfield, Mass.



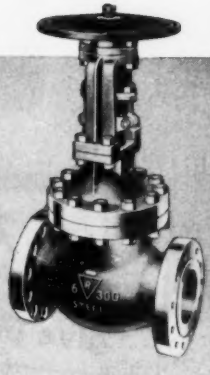
P785 • STANDBY HEATER—Diesel power-plant cooling system coolant is kept constantly circulating by a gasoline-heater when the plant is shut down. In cold weather this keeps the cooling system solution from freezing up.

Heater uses about 1 qt gasoline an hr; develops an output of over 15,000 Btu per hr. About 10% of the coolant system is drawn into three copper coils in the heating chamber and turned into steam. Steam heats and circulates the solution by ejecting through two venturi nozzles. Heater measures 18x5¾x9¾ in. and weighs 33 lb.
Vapor Heating Corp, Chicago, Ill.

P777 • SYNTHETIC LUBRICANTS—These synthetic oils have good low-temperature characteristics and, in addition, will not form sludges that would interfere with proper lubrication. Chemically, *Ucon* lubricants are a series of synthetic organic chemicals of the polyether type.

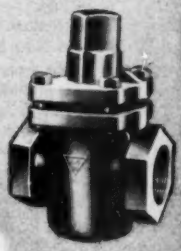
These synthetic lubricants are comparable to petroleum oils, yet do not contain petroleum oil; they are wax free. In addition, the *Ucon* lubricants change little in viscosity over wide operating tempera-

"VALVE MEN" LIKE R-P&C VALVES

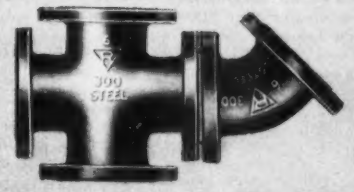


Men who really know valves—know where to look for those details of design and construction that insure top performance—have a lot of respect for Reading-Pratt & Cady.

An R-P & C valve must be more than just an assembly of machined parts. It has work to do. R-P & C feels the responsibility for that work being done faithfully.



Consider your R-P & C distributor as your "valve man"—a responsible source for bronze, iron and steel gate, globe, angle and check valves—Bar Stock valves—iron cocks—Lubrotite gate valves—cast steel fittings.



ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit • Houston • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

READING-PRATT & CADY

Look to these five reasons for long, trouble-free service in STRONG 70 Series Traps:

1. *Valve and seat guaranteed leakproof for one year—made of STRONG's patented, wear-resistant Anum-Metl;*
2. *Easy servicing—permitted by the renewable seat design, cover with all working parts easily removed without breaking pipe connections;*
3. *One piece bucket—stainless steel, no welds;*
4. *Turbulence avoided, choking minimized, 25% greater capacity—with STRONG's exclusive Hi-Cap orifice;*
5. *No dribbling, quick, full opening—high ratio leverage.*

STRONG *in-line* 70 Series Traps are available in sizes from ½" to 1", semi-steel construction. STRONG's "two-in-one" blast trap with integral thermal air vent is also available in the 70 Series (see cut below).

Catalog No. 68 describes these traps in detail along with other STRONG traps. Write today.

*Trademark Reg. U. S. Pat. Off.

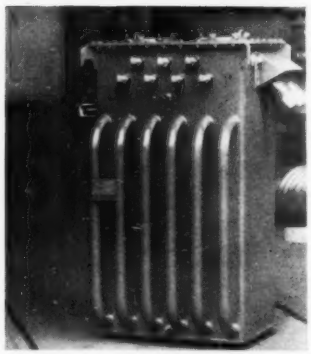
STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

ture ranges. They are available in water soluble and water insoluble grades.
Carbide & Carbon Chemicals Corp, 30 E 42nd St, New York 17, N. Y.

P780 • CHROME-WELDING—Chrome electrode Type *W*-1502 in conjunction with an oxyacetylene tip (oxyacetylene preheats welded member to 600-800 F and holds it there.) achieves effective chrome-pipe welding. After completing weld, raise pipe temperature to 1200-1350 F and wrap with asbestos tape to a 1-in. minimum thickness. Then allow to cool.

Resulting weld gives an ultimate tensile strength of 73,200 psi, a brinell hardness of 248 (pipe hardness was 174). Chemical analysis of the weld showed 7.73% cr in the weld and 4.53% in the pipe.
General Electric Co, Schenectady, N. Y.



P786 • 3-PHASE TRANSFORMERS—Designed for 4-wire, 208-Y 120-v secondaries, these new transformers when used in banked secondary systems reduce light flicker resulting from motor loads, increase service reliability, and reduce necessary installed capacity.

An extra secondary breaker within the transformer and additional low-voltage bushings provide proper sectionalizing of secondary without need for additional equipment. *CSPB* transformers are available in 75-kva ratings in standard high-voltage ratings from 2400 to 14,400 v inclusive.
Westinghouse Electric Corp, P O Box 868, Pittsburgh, Pa.

P787 • HEAT-TRANSFER COILS—Dual heat-transfer coils for heat exchange between liquids and gases are available from stock as pre-engineered units. Coils serve for cooling steam or water-test samples on boilers of all ratings, in refrigeration equipment, in oil still and in hydraulic circuits for cooling oil.

They come in two ratings: (1) For pressures up to 1000 psi and temperatures to 700 F, seamless copper tubing and bronze fittings make up the six standard-size units available. (2) Where pressures range to 2000 psi and temperatures up to 1500 F, outer coils are seamless copper; inner coils, stainless steel. End fittings are stainless and coil terminals are carbon steel. There are three stock sizes.

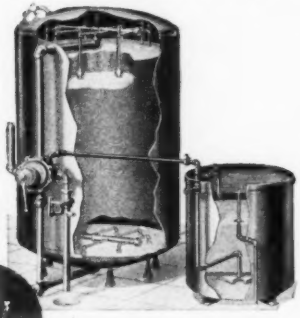
In standard sizes outer coils are 19½ ft

TWO WAYS

to cut water softener costs

In thousands of installations the Elgin "Double-Check" principle has proved the most revolutionary development in Zeolite water softeners in recent years. The operating records of these installations show that the "Double-Check" softener delivers up to 44% more soft water, size for size, than any other—costs less to buy and operate.

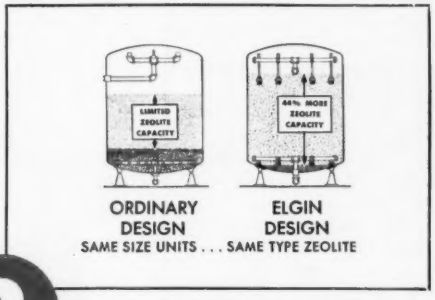
Note that there are two ways you can cut water softener costs with the "Double-Check" principle as pointed out here:—



1 ***By installing a new Elgin "Double-Check" Softener***

The accompanying diagrams show why the Elgin "Double-Check" Softener gives up to 44% more soft water per regeneration than others. Note that a softener of conventional design is compelled to use far less zeolite than an Elgin of equal size because it has no means of preventing the escape of zeolite during backwashing.

In the Elgin Softener, the "Double-Check" manifold arrangement prevents loss of zeolite even at a far higher backwash rate. The deeper zeolite bed that can be carried, means more water softening capacity, and the higher backwash rate means better opening up of the bed, more thorough regeneration by the brine, *more efficient utilization of more zeolite!* (This means that a smaller Elgin does the work of other larger softeners.)



2 ***By having the "Double-Check" Method applied to your present softener***

The dollar-saving advantages and extra capacity of the Elgin "Double-Check" manifold system can be fully realized by having it applied to any existing water softener. Indeed there could be no better proof of the merit of the "Double-Check" principle than the fact that operating men have had it applied to hundreds of softeners of every make.

Our district engineer will be glad to show you how your present softener of any make can be modernized (without having to buy a new unit) by installing upper and lower "Double-Check" manifolds as illustrated here with Elgin high capacity zeolites to suit your conditions. The net result will be a remarkable increase in soft water at far lower cost per gallon. (With the newer Elgin high capacity zeolites, you can get 3 to 10 times as much soft water per regeneration.)

ELGIN SOFTENER CORPORATION

130 N. Grove Ave., Elgin, Ill.

Representatives in principal cities

Let an Elgin Engineer help you plan

Every engineer knows that no single piece of equipment—no one method—offers a solution to *all* water conditioning needs.

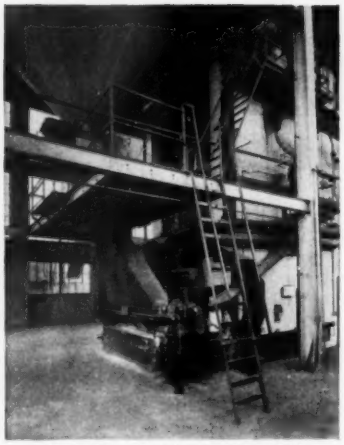
Since Elgin offers *all* authoritative methods—softeners, post treatments, boiler feed water treatments, corrosion prevention, filtration, taste and odor correction—we are bound by no method except the *one best method.*

An analysis of your problem by your nearby Elgin engineer will show you that the Elgin way is the low cost way—the undivided-responsibility way.

ELGIN ECONOMICAL WATER CONDITIONING

SOFTENERS • FILTERS • BOILER TREATMENT • BOILER WATER CONDITIONING

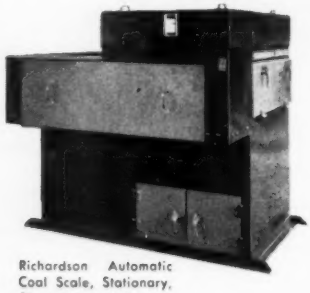
TWO WAYS TO STOP COAL WASTE



Installation at mid-western Municipal lighting plant showing Richardson Coal Gate, Coal Scale and "Monorate" Non-Segregating Distributor.

1

RICHARDSON COAL SCALES: One over each boiler automatically gives you a record of coal consumption, by the hour, shift, day, week or month, in stoker or pulverizer firing. You spot inefficient steaming right away, *before* you start paying invisible bills for wasted coal.



Richardson Automatic Coal Scale, Stationary, Floor Mounted Style.

2

RICHARDSON "MONORATE" DISTRIBUTORS. An original Richardson development* which absolutely stops coal segregation in stoker-fired installations. The "Monorate" is just what its name implies—the curved top plate, developed in theory and proven in practice, causes *all* the coal, both lumps and fines, to descend at the same rate so there is no tendency for lumps to separate. You get the same mix across your stoker hopper as you had at the bunker outlet so that most efficient combustion is assured.

*Patent Pending No. 2,258,516

Richardson "Monorate" Distributor Showing Patented Design of Top Plate Which Keeps Lumps and Fines from Separating.

For further details on Richardson Coal Scales, write for Bulletin No. 1143, and at the same time ask for the new Richardson "Monorate" Bulletin No. 1349-P.

A COMPLETE RICHARDSON INSTALLATION:

Leakproof **Gate** from the bunker; flexible **Inlet** to scale; **Automatic** Coal **Scale**; **"Monorate" Non-Segregating Distributor** to stoker; or down-take **Chute** to pulverizer.

RICHARDSON SCALE COMPANY, Clifton, N. J.

ATLANTA • BOSTON • BUFFALO • CHICAGO • MINNEAPOLIS • WICHITA

NEW YORK • OMAHA • PHILADELPHIA • SAN FRANCISCO • DETROIT • PITTSBURGH • MONTREAL • TORONTO

5314

in length; inner coils, 20 ft. External-tube sizes range from ½ to 1½ in. OD; internal tubes from ¼ to 1 in. From 5 to 13 coils are used, depending on size. Coil OD is from 5 to 13 in.
Parker Appliance Co, 17325 Euclid Ave, Cleveland 12, Ohio.

P774 • VOLTAGE REGULATOR—Input voltage range of this regulator is from 95 to 135 v, while the output is adjustable between 110 and 120 v. Rated output is 0-500 va and frequency of 60 cps + or — 10%.

Load power factor range is 0.5 lagging to 0.9 leading. Stabilization is maintained at + or — 0.1 of 1% of preset value. Recovery time is 3 to 6 cycles.
Superior Electric Co, Bristol, Conn.

P784 • DUST COLLECTOR—Hydrostatic precipitator cleans air by centrifugal force developed in an air stream by a fan and a thorough intermixing of water and dust-laden air, re-using the water without recirculation pumps or spray nozzles.

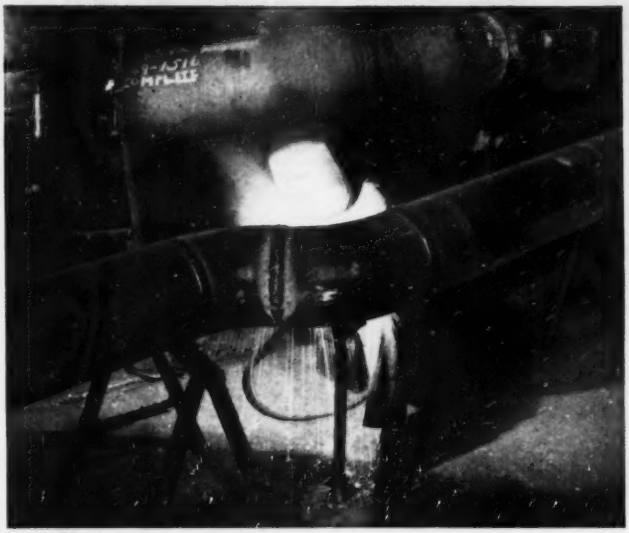
Design 2, Type *N Roto-Clone*, with capacities up to 48,000 cfm, maintains a low-pressure drop under operation from 50 to 120% of rating. All sizes are available in either manual clean-out, sludge ejector or hopper bottom.
American Air Filter Co, 215 Central Ave, Louisville, Ky.

P770 • FUEL-OIL TREATMENT—*Dacarol "A"* is an activated fuel-oil treatment that readily attacks oil sludge and water condensation. Manufacturer says *Dacarol* prevents carbon deposits in preheaters and on burner tips.

It is applied directly to storage tanks in proportionate dosages per 1000 gal of oil.
Dacar Chemical Products Co, Pittsburgh, Pa.

P767 • SPEED INCREASER—By replacing the standard handpiece or angle heads used with many of this company's flexible shaft machines, the shaft speed may be increased three times. For example,

how to GET MORE WELDING from your PIPE WELDERS



The exceptional accuracy and uniformity of Midwest Welding Fittings enable the welder to spend more time in welding and less time in preparation. He does not have to struggle to line up fittings and pipe . . . all pipe can be cut in advance according to drawings . . . he need never compensate for inaccuracies. Time and money savings are substantial.

The dimensional accuracy and uniformity of Midwest Welding Elbows result from a unique method of manufacture. These elbows are first made slightly oversize . . . then reheated to forging temperature and brought to final size in *compression dies*. This assures true circular cross section, uniform wall thickness and accurate radius, included arc and tangents.

Midwest Welding Fittings save you money . . . there is a distributor near you . . . it will pay you to call him.

3718

MIDWEST

PIPING & SUPPLY COMPANY, Inc

MAIN OFFICES: 1450 SOUTH SECOND ST., ST. LOUIS, MO.
PLANTS: ST. LOUIS, PASSAIC (N.J.) and LOS ANGELES

MIDWEST WELDING FITTINGS Improve Piping Designs and Reduce Costs

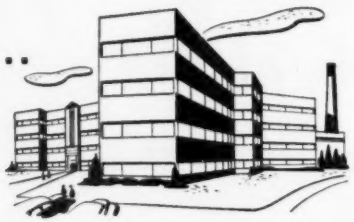
SALES OFFICES

New York (7), 30 Church St. • Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg. • Tulsa (3), 533 Mayo Bldg. • South Boston (27), 426 First St. • Distributors in Principal Cities.

CORAVOL LINES BOILER **CASE HISTORY NO. 5**

5th in a series describing CORAVOL results in steam systems

Type of Operation...



HOSPITAL

OPERATING CONDITIONS: 180,000 lbs. evaporation per 24 hours.

25% make-up.

Boiler pressure—75 psi.

Steam used for heating, laundry, sterilizing and cooking.

PROBLEM: Internal corrosion of lines of steam system, requiring numerous replacements.

CORAVOL STARTED: April 1940.

RESULTS: Replacements of lines and fittings of steam system practically eliminated.

USER COMMENTS: Removal of old rust deposits throughout steam system was gradual and no stoppage resulted in lines or traps.

STOP STEAM SYSTEM CORROSION

with **CORAVOL** (the original* AMINE PROCESS)

CORAVOL in your steam system (1) prevents corrosion in lines, (2) cleans out clogging rust deposits. Thus, CORAVOL *protects lines;* improves heat transfer; restores original capacity of lines and efficiency of valves and traps.

CORAVOL is *not* a boiler feed water treatment—it is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates throughout your entire steam system and protects *all* zones from corrosive attack.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of treatment for: boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply.

*The use of CORAVOL in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

WRITE TODAY for complete *free* data about the CORAVOL process.

WESTERN CHEMICAL COMPANY

713 Washington Street — Kansas City 6, Missouri

on standard 3600-rpm single-speed flexible shafts on machines manufactured by this company, small diameter rotary files, mounted grinding wheels or abrasive sanders with a speed of 18,000 rpm can be used.

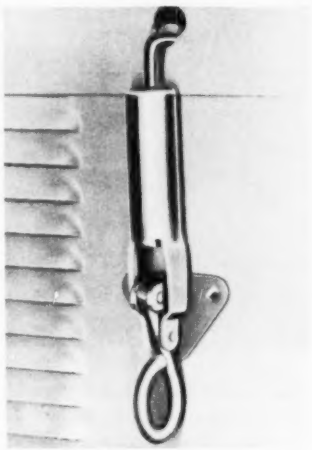
Hand piece is available in two sizes to fit the various flexible shafting manufactured by this company.

Wyzenbeek and Staff Inc, 838 W Hubbard St, Chicago 22, Ill.

P776 • COLD CATHODE LAMP—This new lamp will operate in any standard *Slimline* or cold-cathode fixture and features a high level illumination in addition to low wattage and long life. The *UHE*-200 lamp provides 75 lumens per watt.

This instantaneous starting lamp will absorb shock, is unaffected by frequent starting or humidity, can be dimmed and will operate in below-freezing temperatures.

Colonial Electric Products, Inc, East Paterson, N. J.



P768 • HOOD FASTENER—Heavy-duty, spring-loaded hood fastener holds metal flaps, panels and hoods tightly closed. It serves air-conditioning ducts, power plants, heating equipment.

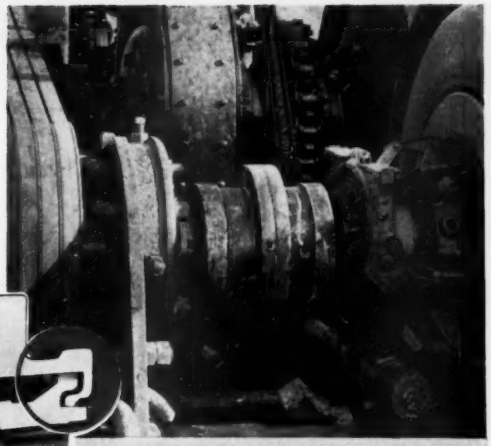
Hood latch weighs about 10 oz, measures 7 in. in length. It has a take-up of 7/16 in. and retains, in closed position, around 40- to 50-lb tension. Three rivets hold the fastener in place. A hole drilled through the metal panel to be held accommodates a bolt unit. To close, push down spring fastener handle and bolt locks against rim of hole.

Donaldson Co, 666 Pelham Blvd, St. Paul, Minn.

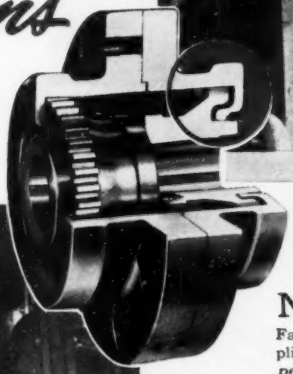
P781 • COPPER OXIDE RECTIFIER—This new *Rectox* copper oxide battery charger is particularly suited for on-the-spot charging of industrial truck batteries in warehouses and industrial plants. This charger features a saturable reactor control to provide smooth, easily made adjustments in output by variation of the inductance.

This device may be obtained as a com-

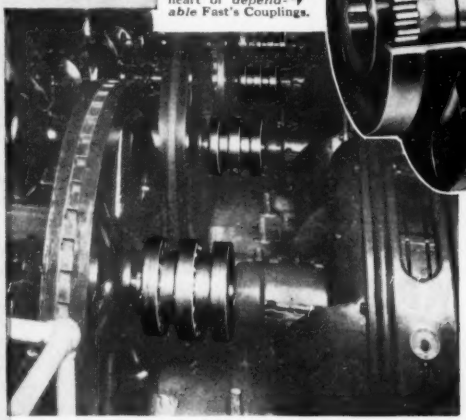
Here's Freedom from *Coupling Shutdowns* for ALL INDUSTRIES



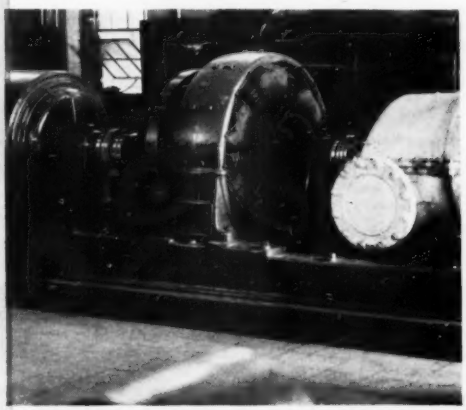
IN OIL FIELDS Fast's are in service to compensate for shaft misalignment, in all kinds of weather, subject to moisture, dirt and grit . . . yet they transmit power without costly coupling shutdowns!



Here's the *exclusive* "rocking bearing," heart of *dependable* Fast's Couplings.



CHEMICAL PROCESSING plants use Fast's Couplings because *exclusive* metal-to-metal seal keeps out impurities—eliminates lost time due to coupling failure! These Couplings have been in service since 1922!



POWER PLANTS use Fast's Couplings to correct shaft misalignment because *exclusive* metal-to-metal seal and the absence of perishable parts virtually eliminate shutdowns.

NO matter what you make—no matter how much horsepower you use in a year—Fast's Couplings virtually eliminate all coupling failure in your plant! There are *no perishable parts* to wear or fail in Fast's! Nothing to replace . . . they're easy to maintain. Even the load-carrying oil is *completely guarded* by a positive metal-to-metal seal formed by exclusive "rocking bearing" principle of construction.

With Fast's on your job you can forget about coupling shutdowns. Correctly engineered position of oil-protecting "rocking bearing" allows for *freedom of movement* to compensate for misalignment because its *spherical base* has *the same axis* as the hub spline faces. No perishable packing rings are used at this critical spot . . . or elsewhere!

When you order Fast's you get years of top engineering experience, Koppers' high standards of workmanship and unexcelled service, including available parts if required by change of drive, *even if your Fast's have been running for 30 years!* For full information mail the coupon below. Address Koppers Co., Inc., Fast's Coupling Dept., 247 Scott Street, Baltimore 3, Md.

KOPPERS

FAST'S *Self-Aligning* **COUPLINGS**

SEND FOR FREE CATALOG!

KOPPERS CO., INC., FAST'S COUPLING DEPT., 247 Scott Street, Baltimore 3, Md.

Please send me the free catalog that gives complete detailed information about Fast's Couplings.

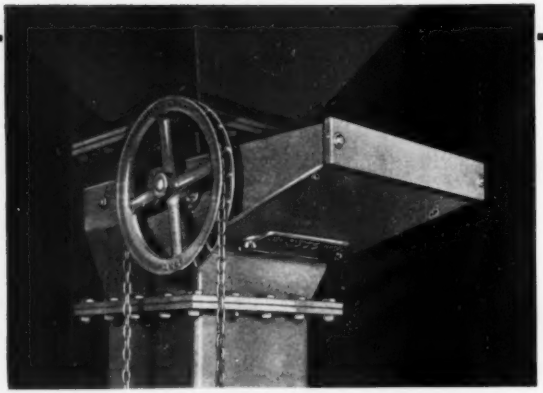
NAME..... TITLE.....

COMPANY.....

ADDRESS.....

CITY..... ZONE..... STATE.....

mail today



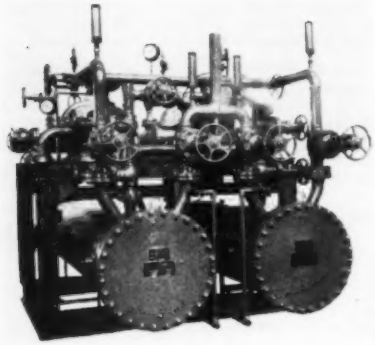
S-E-Co. COAL VALVES have dust-tight construction. Valve bodies are welded into one unit from heavy steel plate. Access openings are closed with heavy, gasketed covers. For a clean boiler plant, use S-E-Co. Coal Valves.

Write for Bulletin

STOCK ENGINEERING COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

LOCKETT FUEL OIL PUMPING AND HEATING SETS

Custom Built



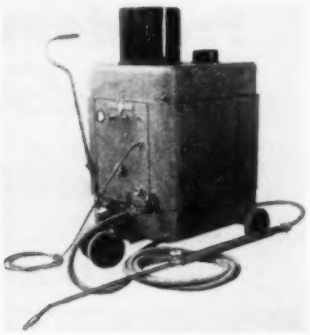
The compact, high-pressure unit illustrated consists of two, Turbine-driven Rotary Pumps and two, Shell-and-tube-type Oil Heaters mounted on a single frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built, Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump-and-heater is suitable for the full rated capacity of the unit; the second pump and heater are spares. Lockett supplies everything, complete. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

bination unit to charge either lead-acid or nickel-alkali batteries. Either type of battery may be fully charged in less than eight hours. The unit operates at either 230 or 460 v.

Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa.



P753 • STEAM CLEANER — Small, requiring 27x37 in. of floor space, portable or stationary industrial steam cleaner, *Hypressure Jenny*, develops from 80- to 120-psi working pressure and delivers a rated 45 gal per hr of cleaning spray.

All the unit needs is an ordinary electric-light outlet, service cold-water connections and, if permanently installed, an 8-in. flue connection to make it ready for service. Cleaning solution tank holds 11 gal and the fuel oil tank 13. Equipment has automatic ignition, instant steaming, automatic nozzle control as regular features. A special *Adjusta-Blast* gun fitting steps up output to 240 gal per hr.

Hypressure Jenny Div, Homestead Valve Mfg Co, Coraopolis, Pa.

P725 • SPLIT-CORE METER—Combined ammeter and voltmeter has five current ranges up to 1000 amp, and three voltage ranges up to 700 v. Known as Model 633 Type *VA*-1, the unit is designed to measure current and voltage without interrupting electrical service.

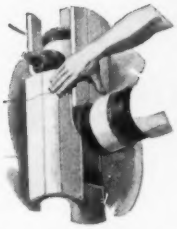
Jaws accommodate bare or insulated con-

(Continued on page 194)

HOW WOULD YOU INSULATE THIS FLANGED FITTING?

4" line requires 85% Magnesia 2" thick on all surfaces, including fittings. Which form of insulation is best for the flanged fitting shown here?

☐ 85% Magnesia cement built up to a total thickness of 1½", then ½" asbestos cement applied in two coats.



☐ 85% Magnesia block, carefully fitted, wired in place and finished with asbestos cement.

HERE'S HOW AN ARMSTRONG FOREMAN DID IT:

Whether to use block insulation on a fitting, or to cover it with built-up cement, is a decision that is usually left to the foreman on the job. Both methods are widely used, but the correct choice depends mainly upon the size of the fitting. In the case outlined above, the Armstrong foreman directed his workmen to use method No. 2. For fittings on pipe lines 4" and larger, this method is always more satisfactory. It is faster than laboriously building up the fittings with multiple layers of cement. Also, it eliminates the shrinking and resultant cracking that occurs when built-up cement is used to insulate a fitting of this size.

On pipe sizes smaller than 4", a neat, efficient job can often be done with cement. However, the size and complexity of the fitting must be taken into consideration, and the most satisfactory method selected for the insulating job at hand.

How well the foreman makes his decision can affect the final appearance and efficiency of every insulation job where covering a fitting is called for in the specifications.

Foremen on Armstrong jobs, as well as Armstrong's own construction superintendents and sales engineers, are trained to make the right decisions. There's no blind rule of thumb. When you call upon Armstrong's Contract Service for heat insulation, your needs, and the requirements of your job, determine the methods used.

FREE BOOKLET

Write today for 28-page booklet, "Armstrong's Industrial Insulations." It contains a chart listing types and thicknesses of insulation for all temperatures. Armstrong Cork Company, 7007 Maple Ave., Lancaster, Penna.

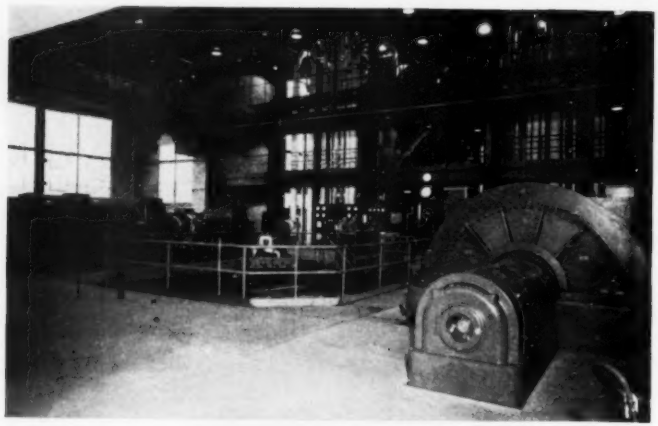
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service
For All Temperatures

From 300° Below Zero

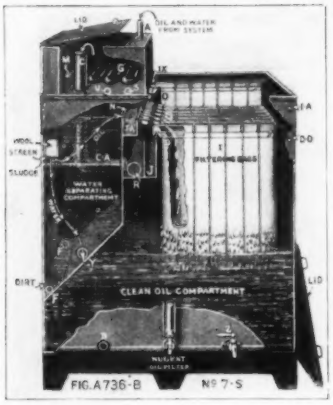
To 2800° Fahrenheit

Behind the scenes
is this modern turbine room



NUGENT
LUBRICATING OIL FILTERING SYSTEMS
protect expensive equipment and reduce maintenance

In the efficient, up-to-date power plant of the Dairyland Power Cooperative at Alma, Wisconsin, Nugent Oil Filtering Systems are used to solve the filtering problem dependably and economically. Experience in plants of this type show that average oil savings with Nugent Gravity Oil Filters coupled with Nugent Pumps, Sight Overflows, Transfer tanks, etc., are in excess of 95%. And the corrosion problem, so prevalent today, is also solved since Nugent filters neutralize acidity and maintain a safe value. A continuous supply of CLEAN, NEUTRALIZED oil is one of your best assurances of getting the excellent service your turbine equipment was built to give. For long term economy you just can't afford to be without Nugent Oil Filters.



Nugent Gravity Oil Filters are available to meet every need. Write today for full details and descriptive literature.

Wm. W. Nugent & Co., Inc.
402 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Established 1907

Representatives in Boston • Cincinnati • Detroit • Houston • La Junta, Colo. • Los Angeles • Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco • Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

POWER NEWS

(Continued from page 134)

and lubricants, or it may be used directly in polishes, insulating materials and chemicals. The alcohols also are useful in the chemical industries.

Compton Elected McGraw-Hill Director

Dr Karl T Compton has been elected a director of the McGraw-Hill Publishing Co. Dr Compton is chairman of the research and development board of the National Military Establishment and chairman of the corporation of the Massachusetts Institute of Technology. Until recently, he was president of MIT, and during his career, has held many important public and private research and administrative positions.

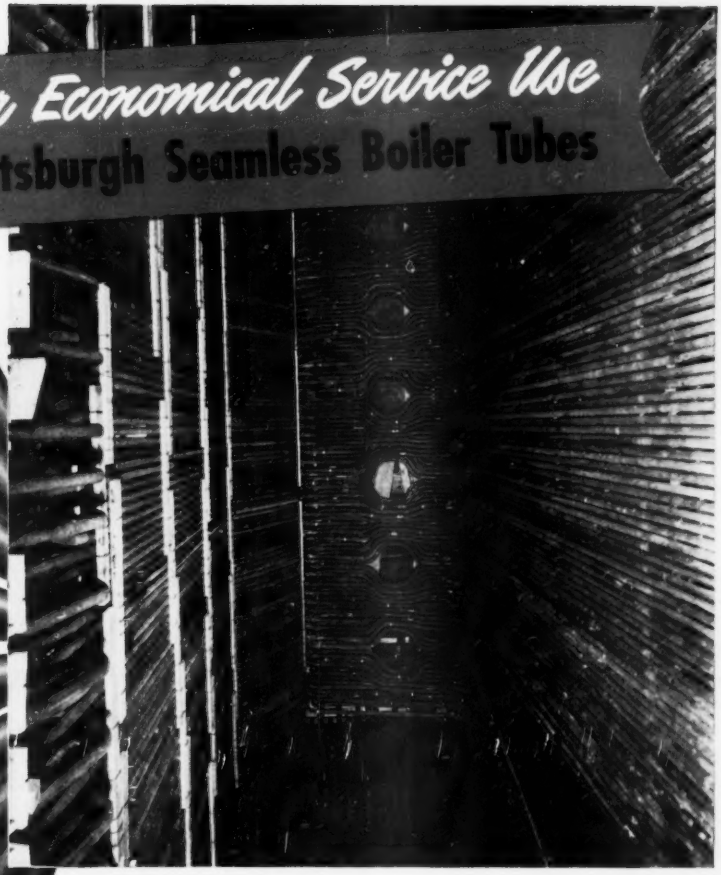
The McGraw-Hill Publishing Co welcomes the counsel and guidance of Dr Compton, an outstanding scientist and educator, in connection with its publication of technical books and magazines, and takes particular pleasure in announcing his election to its board.

Koppers Co. Inc, Pittsburgh, Pa., announces that it has contracted to purchase the Freyn Engrg Co, Chicago, Ill., one of the nation's best-known engineering firms specializing in design and construction of blast furnaces and open hearth furnaces, and in engineering of mills, power stations and other steel mill facilities. The acquisition will also include the Open Hearth Combustion Co, a Freyn subsidiary.

General Brehon Somervell, president of Koppers, said the purchase of Freyn is to be consummated through exchange of Koppers common stock for stock of Freyn Engrg. Freyn will continue under its present name and for the time being will be operated as a wholly owned subsidiary of Koppers. There will be no changes in policies or personnel.

James T Lawson, who had been electrical operating engineer in the electric generation dept, Public Service Electric and Gas Co since 1931, concluded a long, active and varied career April 22nd. He retired on pension after more than 31 years' service with Public Service and predecessor companies.

For Economical Service Use
Pittsburgh Seamless Boiler Tubes



For long economical service at high pressures and high temperatures specify Pittsburgh Steel Seamless carbon and alloy boiler tubes. They have the ductility and size accuracy to give you ease of installation—the closely controlled chemistry and tensile strength to give long service. Pittsburgh Boiler Tubes are supplied with plain ends or swaged, expanded or upset. Write for complete information on how you can get economical service with Pittsburgh Seamless Boiler Tubes.

Pittsburgh Steel Company

GRANT BUILDING • PITTSBURGH 30, PA.

Creator of profits — not consumer — is maintenance that steps up availability and betters performance of steam generating equipment.

Whether metal serves wet or dry, under high heat or cold, there's a Dampney surfacing material to guard against ills that threaten steel . . . to hold power-producing equipment to full-life peak efficiency.

These benefits are being enjoyed today in plants where Dampney coatings were first introduced more than thirty years ago. Yours to call upon freely is the experience thus gained in long association with steel that serves power.

For general information, ask for product bulletins 1500, 1530 and 1540.

DAMPNEY Maintenance for Metal

THE DAMPNEY COMPANY of AMERICA • Hyde Park, Boston 36, Mass.

Industrials Announce Product Price Reductions

Price reductions ranging from 3 to 14% on standard sump-pump motors, oil-burner motors, belt-drive fan motors, and certain horsepower ratings of standard jet-pump motors have been announced by M E Lord, manager of General Electric's fractional horsepower motor divisions. According to Lord, the reductions were made possible through cost improvements resulting from standardization in these definite-purpose motor lines. He emphasized that the price reductions apply only to these definite-purpose models and that no general price change is contemplated.

A price reduction of 7 to 19% on multiple V-belt had been made by Allis-Chalmers Mfg Co, Milwaukee, Wis. This became effective April 11. Reductions apply to all types of the company's multiple V-belts, sheaves and accessories sold under the trade name, *Texrope*. Lower prices were made possible through lower basic material costs and recent changes in manufacturing facilities resulting in increased production efficiency.

Rockwood Mfg Co, Indianapolis, Ind., has reduced prices on all stock sizes. This became effective May 1, 1949, and price reductions range 12 to 25%. The Rockwood line covers all types of V-belt sheaves and paper pulleys up to 84 in. dia, together with weatherproof outdoor pulleys, pivoted motor bases, fiber frictions, rolls, *Keystock* and belt dressing.

Courtesy of Fabian Bachrach

F Leon Yetter has joined the Kuljian Corp, of Philadelphia, engineers and constructors, as personnel director in their foreign dept. His initial duties are in connection with a contract recently awarded to design, construct and operate a new 200,000-kw steam power plant for the government of India. Yetter recently resigned as vice-president and assistant general manager of C H Wheeler Mfg Co to join the Kuljian Corp.

Queen City Engrg Co has moved into its plant at 630 Dowd Rd, Charlotte, N. C., and started production on its new "package" watertube boilers to be distributed nationally. The high-pressure steam boiler ranges from 25 to 150 hp and is fired either by coal, oil or gas.

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

BOILERS AND AUXILIARIES

1 **VACUUM FLUE CLEANER**—Hosmer Products Corp, 815-821 Massachusetts Ave, Indianapolis 4, Ind. 4-page bulletin describes modern way of cleaning boiler flues. A list of users is included.

2 **COAL SCALE**—Stock Engrg Co, Hanna Bldg, Cleveland, Ohio. 12-page booklet features a dust-tight, automatic coal scale consisting essentially of three major assemblies: a belt feeder, weigh lever with pivots, and a weigh hopper. Operation and designs of this scale are illustrated.

3 **COMBUSTION SAFEGUARD** — Combustion Control Corp, 77 Broadway, Cambridge 42, Mass. Fireye bulletin CG 4752 gives informative data on a flame failure safeguard for boiler protection. Equipment includes electronic flame rod Type 45JQ1 and control Type 24QJ6.

4 **GAS BURNERS**—North American Mfg Co, 4455 E 71st St, Cleveland 5, Ohio. 4-page bulletin No. 58 tells about combustion gas burners. Exact air-to-gas ratios can be set by a pointer and dial arrangement on the burner. Design data and list prices are given.

5 **FIRING EQUIPMENT** — Eclipse Fuel Engrg Co, Rockford, Ill. Form L-904 shows the McKee diluter—a gas-air premix machine. This cone-type diluter mixes gas and air automatically in any quantity, in correct proportions.

6 **COAL CRUSHERS**—American Pulverizer Co, 1349 Macklind Ave, St. Louis 10, Mo. 8-page bulletin, entitled "Crushing Coal at Less Than One Cent Per Ton," gives capacities, ratings, and dimensions of the complete group of Type "S" ring crushers.

7 **FURNACE WALLS**—Geo. P. Reintjes Co, 2517-19 Jefferson St, Kansas City Mo. 4-page bulletin No. 449 discusses value of suspended walls for boiler furnaces, with an illustration of a sectional view of sectionally suspended wall and arch.

CONTROLS, ELECTRIC

8 **PUMP CONTROLS** — Cutler-Hammer Inc, 294 N 12th St, Milwaukee 1, Wis. 37-page booklet of specialized data, entitled "Precision Control for Pumps," describes control for domestic, commercial and industrial water systems.

9 **RELAYS**—Ebert Engrg & Mfg Co, 185-09 Jamaica Ave, Hollis 7, L. I., N. Y. 4-page bulletin covers Ebert's redesigned and improved line of Mercury relays. Outline drawings, photographs and technical data are shown.

10 **MOTOR STARTERS**—Ward Leonard Electric Co, 31 South St, Mount Vernon, N. Y. 4-page sales bulletin lists prices for starters with and without overload relays. Application and construction details are given.

11 **ELECTRIC REGULATORS**—General Regulator Corp, 165 Broadway, New York 6, N. Y. 16-page bulletin No. GR-48-14 features all-electric regulators for speed, pressure and flow control. Actuators and combustion controls are also discussed.

12 **ELECTRONIC MOTOR CONTROL UNIT**—Servo-Tek Products Co, 4 Godwin Ave, Paterson 1, N. J. 4-page brochure presents a new electronic motor control unit. Details of its operation and application are included.

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

Write here number of item in which you are interested → E17

Your Company Name: Brown Mfg. Co.

Address: 3718 First Avenue

Pottsville, Okla.

Your Name: John Smith

Your Title: Power Engineer

POWER, 330 West 42nd St., New York 18, N. Y.

FILL OUT AND MAIL TODAY! NOT GOOD AFTER OCT 1, 1949

Write here number of item in which you are interested →

Your Company Name

Address

Your Name

Your Title

POWER, 330 West 42nd St., New York 18, N. Y. 7/49

Write here number of item in which you are interested →

Your Company Name

Address

Your Name

Your Title

POWER, 330 West 42nd St., New York 18, N. Y. 7/49

Write here number of item in which you are interested →

Your Company Name

Address

Your Name

Your Title

POWER, 330 West 42nd St., New York 18, N. Y. 7/49

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POWER, 330 West 42nd St., New York 18, N. Y. 7/49

Write here number of item in which you are interested →

Your Company Name

Address

Your Name

Your Title

POWER, 330 West 42nd St., New York 18, N. Y. 7/49

ELECTRICAL EQUIPMENT

13 **ELECTRICAL TAPE** — Minnesota Mining & Mfg Co, 900 Fauquier St, St. Paul 6, Minn. 4-page booklet, entitled "The Most Modern Tool in the Electrician's Kit," tells about an electrical tape that provides abrasion resistance and protection against oils and acids. Illustrations of various uses are included.

14 **BATTERY CHARGERS** — Electric Products Co, 1725 Clarkstone Rd, Cleveland 12, Ohio. 4-page folder illustrates features of the Type S charger. It also gives dimensions and characteristics.

15 **OIL CIRCUIT BREAKER**—Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee 1, Wis. 8-page bulletin No. 71B6022C tells about the Type BZO-160 oil circuit breaker for electrical protection of high-voltage transmission equipment. A table of dimensions is included.

16 **TRANSFORMERS** — Pennsylvania Transformer Co, P O Box 6308, Pittsburgh 12, Pa. 8-page booklet No. 1492 gives informative data on power transformers. Various transformer parts are standardized in such a way that identical parts may be used in several ratings and some variations may be made in some of the electrical characteristics.

17 **BUSWAYS** — Trumbull Electric Mfg Co, Plainville, Conn. 4-page circular No. 152 explains features and advantages of LVD Flex-A-Power, a busway that is used principally as feeder lines for transfer of heavy current or as main feeders for power and light.

18 **ARC WELDER**—Birdsell Mfg Co Inc, P O Box 733, Los Altos, Calif. A single sheet bulletin describes Model No. 170 portable arc welder for general welding and maintenance service. It also contains specifications, operator's instructions and helpful hints on how to handle tricky welding jobs.

19 **GENERATORS** — Empire Electric Co, 87-93 Jay St, Brooklyn 1, N. Y. 36-page stock list catalog No. 49 presents new and rebuilt generators, electric motors, and mg sets.

20 **INDUCTION MOTORS** — Century Electric Co, 1806 Pine St, St Louis 3, Mo. 8-page form No. 942 illustrates repulsion-start, induction, brush-lifting, single-phase motors. These motors combine starting characteristics of a repulsion motor with running characteristics of an induction motor.

21 **INSTRUMENT TRANSFORMERS** —Allis-Chalmers Mfg Co, 951 S 70th St, Milwaukee, Wis. 32-page bulletin No. 61B7168 contains data on various Allis-Chalmers' indoor and outdoor current transformers, indoor and outdoor potential transformers, and outdoor metering outfits.

22 **SYNCHRONOUS MOTORS** — Allis-Chalmers Mfg Co, 953 S 70th St, Milwaukee 1, Wis. 16-page bulletin No. 05B6112A describes operating advantages and construction features of Allis-Chalmers' bracket bearing synchronous motors in sizes from 30 to 1000 hp.

23 **BUS DUCTS**—Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa. 12-page booklet No. B-4271 covers uses of bus ducts in secondary power distribution systems.

24 **DISTRIBUTION TRANSFORMERS** —Marcus Transformer Co, 32 Montgomery St, Hillside 5, N. J. 4-page bulletin No. 49-ACO describes line of air-cooled distribution transformers.

MAINTENANCE AND SAFETY EQUIPMENT

25 **PIPE THREADER** — Armstrong Bros Tool Co, 5200 W Armstrong Ave, Chicago 30, Ill. Sheet No. PPT-165-10M presents the new Armstrong portable power pipe threader. Construction features are given.

26 **METALLIZING** — Metallizing Engrg Co Inc, 38-14 30th St, Long Island City 1, N. Y. 8-page bulletin No. 62 discusses advantages of metallizing iron and steel equipment to protect it from corrosion. Illustrations of various uses of this process are included.

27 **OIL PURIFICATION** — Honan-Crane Corp, 1200 6th St, Lebanon, Ind. 4-page technical bulletin, entitled "Turbine Oil Policy," outlines policy of Honan-Crane on application of its filtration and purification equipment to turbine oils.

28 **DIAMOND WHEEL** — Manhattan Rubber Div, Raybestos-Manhattan Inc, Passaic, N. J. 36-page catalog contains description of types, sizes, list prices and other data on Manhattan diamond wheels.

29 **BLAST GENERATORS**—Ruemelin Mfg Co, 3860 N Palmer St, Milwaukee, Wis. Bulletin No. 36-B gives industrial applications of Ruemelin blast cleaning generators.

30 **TUBE CLEANERS** — Elliott Co, Jeanette, Pa. 4-page brochure No. Y-24 discusses air- and water-driven tube cleaners for small tubes, straight or curved. Disassembled views of motors, circular and expanding brushes, cutter and scraper heads are illustrated.

31 **LUBRICATION**—Farval Corp, 3249 E 80th St, Cleveland 4, Ohio. 8-page bulletin, entitled "Studies in Centralized Lubrication," tells about savings in oiling labor and lubricant consumption, elimination of down time, and increase of machine production reported by users of the Farval lubricating system.

32 **HAND TOOLS**—Ampco Metal Inc, 1745 S 38th St, Milwaukee 4, Wis. 32-page booklet No. 119 contains information about line of Ampco safety hand tools.

33 **PIPE TOOLS**—Toledo Pipe Threading Machine Co, Toledo, Ohio. 52-page catalog covers complete line of Toledo pipe tools, power pipe machines, power drives and accessory equipment.

MAINTENANCE MATERIALS

34 **HOSE CLAMPS**—Hose Accessories Co, 17th & Lehigh Ave, Philadelphia 32, Pa. 4-page folder No. 125 describes LE-HI hose clamps. Featured is a group of new undersize high-pressure hose clamps (interlocking type) designed to fit the many new hose types with smaller outside diameters.

35 **CORROSION-RESISTANT PROTECTIVE COATING** — Dennis Chemical Co, 2701 Papin St, St. Louis 3, Mo. 4-page bulletin entitled "PERMA-SKIN Vinyl Corrosion Resistant Protective Coatings" explains how to

(*Continued on page 188*)

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COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by BRIDGEPORT BRASS COMPANY "Bridgeport" BRASS CO. *Headquarters for BRASS, BRONZE and COPPER*

For Longer Condenser Tube Life

Effect of Slime on Accelerated Corrosion

The problem of condenser tube corrosion continues to be a complicated one in spite of many years of operating experience and laboratory tests to fall back on.

Among the contributing factors responsible for corrosion, the following are particularly influential:

1. Character of Circulating Water
2. Temperature
3. Velocity
4. Foreign matter such as marine organisms, etc.

Operating Conditions Important

Why is it that a certain alloy which has an exceptionally long life in one condenser may fail rapidly by accelerated attack when used in another location even when the distance between the two plants is comparatively short?

Examination may reveal only a slight difference in the character of the circulating water and in the operating temperature between the two plants. The big difference, however, may be found in the water velocity and character and quantity of adhering material that attaches itself to the tube wall in the form of tenacious slime which consists for the most part of algae and bacteria.

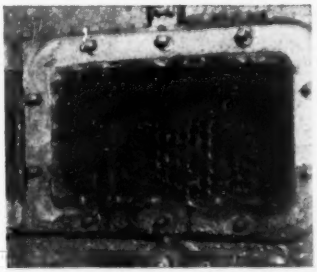
Failure During Shutdown Periods

A case in point is the experience of a power plant located on a fresh water lake, which had no difficulties during six years of continuous operation. However, after a six month shutdown, the condenser was again put into operation and it was found that a number of leaky tubes had developed. Failure was attributed to stress corrosion cracking. During the shutdown period, slime which had accumulated on the inside of the tubes, decomposed with the formation of ammonia gas and other substances. The presence of ammonia, moisture and oxygen had developed cracks in some of the tubes.

Another power plant located on a lake experienced a similar failure when the condenser was shut down for an extended period and water was allowed to remain in the tubing. The rise and fall of the lake raised and lowered the water level in the bank of the tubes resulting in the decomposition of the adhering slime and the formation of ammonia. This condition also led to the cracking of some of the tubes.

Slime Leads to Trouble

Danger of damage from slime is often not recognized until too late. It is considered troublesome because it cuts down heat transfer in main condensers, bringing about a drop in vacuum which may waste fuel. This condition varies with the seasons and nature of pollution from sewage and industrial wastes.



Accumulation of marine growth on condenser water box.

Regardless whether the water is fresh or salt, growth of slime is stimulated by conditions such as favorable temperature, abundant food supply and low water velocity. However, with high water velocities, the minute organisms do not have as good an opportunity to obtain a foothold.

The living organisms in slime give off acid substances which play an important part in corrosion of metals and make it easier for barnacles and other marine organisms to cling to metal surfaces.

Obviously, the answer is to keep the tubing free from slime and the attachment of any other foreign matter. Frequent periodic chlorination followed by cleaning with rubber plugs, high pressure water spray and similar methods will prevent the slime from accumulating. Care should also be taken to guard against a too low water velocity during normal operations.

Cleaning, Drying Out Important For Stand-by Condensers

Since most of this type of trouble occurs in stand-by condensers and heat exchanger equipment during shutdown periods, it is most important to prepare them properly so that the tubes are left clean and dry. Removal of slime and flushing tubes with clean water, followed by drying with hot air or steam, will prevent deterioration during idle periods and has proven successful in many plants.

The character of the condenser tube alloy has considerable influence on the growth and development of slime or other organisms which are trying to settle and attach themselves to the metal.

Fouling Reduces Tube Life

The high corrosion resisting alloys, such as Aluminum Bronze, Aluminum Brass and Cupro Nickel, frequently are more susceptible to fouling than the less corrosion resisting metals, such as Copper, Red Brass, Admiralty, and Muntz. This is explained by the fact that the lower corrosion resisting alloys, when in contact with sea water, release minute quantities of copper salts which have a poisonous effect on microscopic plant and animal life. The higher corrosion resisting alloys, being of a less soluble nature, are not as toxic to them. Therefore, to realize the benefits of the more corrosion resisting metals, it is most essential to keep these tubes clean and free from fouling organisms.

Bridgeport's Laboratory will be glad to cooperate with engineers in helping to determine which alloy will serve best under existing operating conditions.

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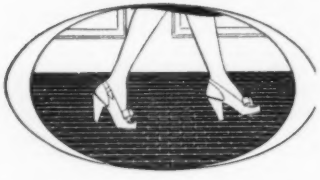

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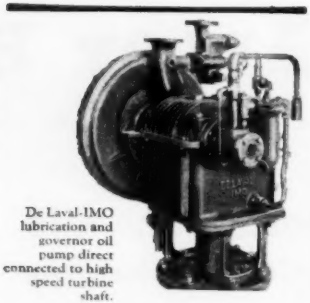

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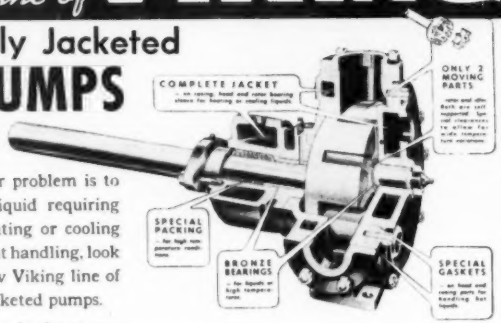

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combat corrosion of metal, wood, stone, brick and concrete structures and equipment, by atmospheric and chemical action.

36 LEAK REPAIR — Stonhard Co, 1306 Spring Garden St, Philadelphia 23, Pa. Folder gives information on Stontite for sealing water seepage or leaks in all types of above and below ground masonry construction.

37 INDUSTRIAL PAINTS—Cheesman-Elliot Co Inc, 647 Kent Ave, Brooklyn 11, N. Y. 32-page graphically illustrated catalog No. 20 features over 75 various kinds of performance tested paints and protective coatings.

38 CLEANING COMPOUND—Magnuson Products Corp, 50 Court St, Brooklyn 2, N. Y. 12-page manual, entitled "Permag No. 168," contains informative data on this cleaning compound. Specific instructions and methods for cleaning operations are given in detailed and tabular form.

39 ELEVATORS AND PORTABLE CRANES — Barrett-Cravens Co, 4609 S Western Blvd, Chicago 9, Ill. 36-page booklet No. 10482 presents comprehensive line of Barrett elevators and portable cranes. Illustrations of features and specifications are included.

40 WIRE ROPE—Macwhyte Co, 2940 14th Ave, Kenosha, Wis. 8-page folder cites questions normally asked about preformed wire rope and also provides the answers to these questions.

41 CONVEYOR BELTS—B. F. Goodrich Co, Akron, Ohio. 4-page bulletin presents illustrated case studies of successful applications of the Giriptop conveyor belts with the non-skid cover, designed for conveying materials at angles of incline too high for conventional belts.

42 CAR SHAKER — Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis. 6-page bulletin No. 07B7221 shows construction features, installation data and specifications on Allis-Chalmers' new car shaker.

METALS AND ALLOYS

43 SHAFT—International Nickel Co. Inc, 67 Wall St, New York 5, N. Y. 8-page booklet, entitled "How to Get the Most From Your New Monel Shaft," discusses advantages of keyways in which the corners of the slot are filleted and are provided with a sled-type runner. Booklet also includes technical information on milling practice and best types of cutters to use.

44 BEARING BRONZE — Magnolia Metal Co, Elizabeth, N. J. Form A is a new size chart on Magnolia isotropic die-cast bearing bronze. Comparison photographs are shown on reverse side.

45 CORROSION-RESISTANT ALLOYS —Duriron Co Inc, Dayton 1, Ohio. 12-page bulletin gives informative data collected on Duriron and Durichlor corrosion resistant alloys in the last ten to fifteen years.

METERS AND INSTRUMENTS MECHANICAL

46 CORROSION-TESTER — Water Doctor Laboratories, 14615 Prevost Ave, Detroit 27, Mich. 8-page bulletin, entitled "The NDHA Corrosion Tester," describes why and how it is used. Technical data tells how the NDHA corrosion tester performs in use.

47 HOUR RECORDER — Barbour Stockwell Co, Cambridge 39, Mass. 3-page literature features the new Reliance Hourmaster, which records number of hours any piece of machinery, or equipment with moving parts, has been operated.

48 RECORDING AND CONTROLLING ROTAMETERS—Schutte & Koerting Co, 12th & Thompson St, Philadelphia 22, Pa. 12-page bulletin No. 18-RC shows photographs, cut-away views, sectional drawings and functional diagrams of electronic, electric and pneumatic recording and controlling rotameters. Text explains construction, operation and application of these rotameters.

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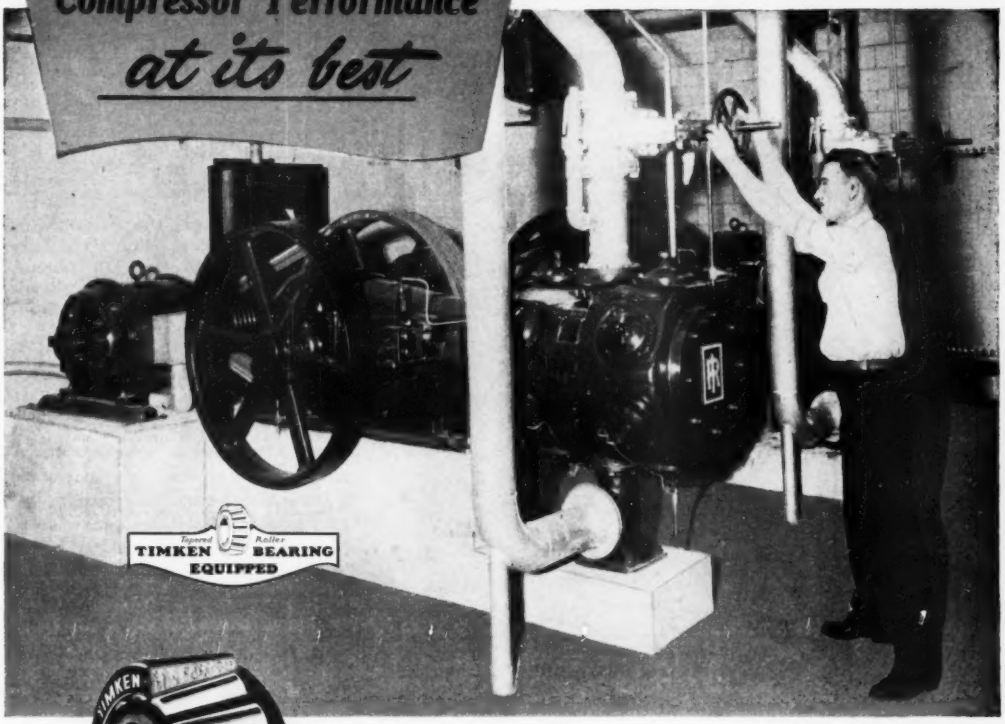

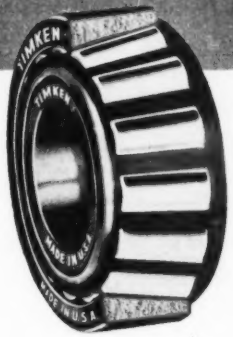

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49 **ROTAMETER**—Brooks Rotameter Co, P O Box B-19549, Lansdale, Pa. 4-page booklet No. 6 gives technical information, including dimensions, about the Brooks' Full-View rotameter with safety shielding. Booklet also describes several new rotameter forms.

PIPING, FITTINGS, VALVES AND SPECIALTIES

50 **VALVES, STRAINERS** — Henry Valve Co, 3215 North Ave, Melrose Park, Ill. 16-page catalog No. 99 illustrates packless and packed valves, relief and check valves, strainers and driers, and liquid-level gages for refrigeration, air conditioning and industrial applications.

51 **PIPE MARKERS**—W H Brady Co, Dept 93, 815 N Third St, Milwaukee 3, Wis. 4-page folder lists Brady's new self-adhesive "Quick-Label" pipe markers. The markers conform to ASA Standard No. A13, "Identification of Piping Systems." Sample pipe markers are available without charge.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

REFRIGERANT SERVICE HOSE★—Chicago Metal Hose Corp, Maywood, Ill. Bulletin contains data on a charging hose of new type construction. Sizes and list prices are given.

52 **PRESSURE-SEAL VALVES**—Edward Valves Inc, East Chicago, Ind. Catalog 12-H discusses details of design, material specifications, pressure-temperature ratings, and charts for correlation of valve size and pressure drop. Complete information is also given on the latest cast steel valve designs with pressure-seal bonnets for high pressure and high temperature service.

53 **WATER-HOSE**—B F Goodrich Co, Akron, Ohio. 4-page catalog section No. 4800 pictures and explains construction of each type water hose the company manufactures, lists recommended uses and gives detailed specifications and coupling information.

54 **COMPANY LINE**—Badger Mfg Co, 260 Bent St, Cambridge 41, Mass. 4-page booklet gives some of the equipment Badger manufactures, such as piping, expansion joints, pressure vessels, heat exchangers, special coils.

55 **HYDRAULIC CONTROL HOSE**—B F Goodrich Co, Akron, Ohio. 4-page catalog section No. 4030 lists many of the uses for hydraulic control hose. A method of calculating correct bending radii for various hose sizes and illustrations of reattachable couplings are among other features of the section.

PRIME MOVERS AND ACCESSORIES

56 **DIESEL ENGINES** — Caterpillar Tractor Co, Peoria 8, Ill. 12-page bulletin, Form No. 12113, entitled "Industry Uses Caterpillar Diesels," presents an informal question-answer format on various problems confronting industrial power usage in the equipment field.

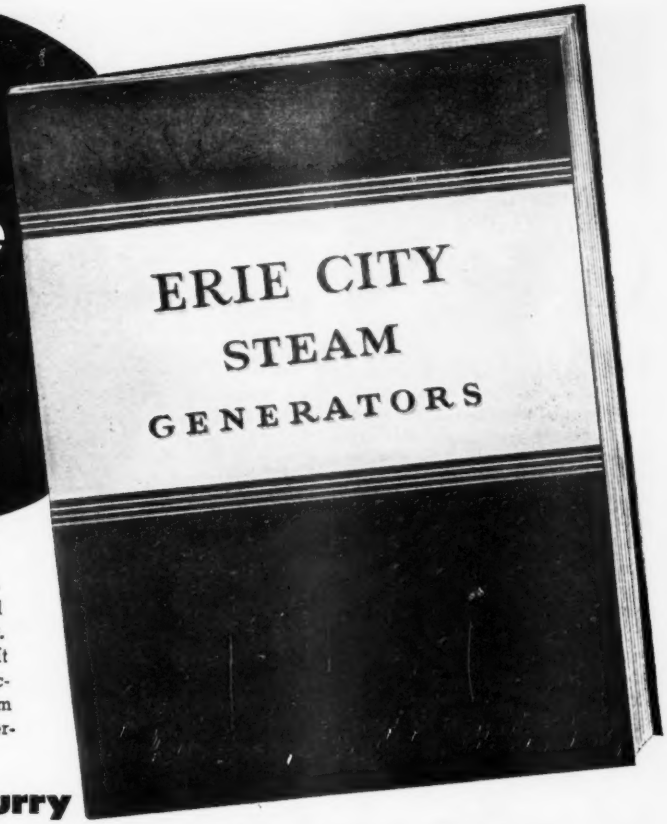
57 **DUAL FUEL ENGINES**—Superior Engine Div, National Supply Co, Springfield, Ohio. 8-page bulletin No. 4811 gives features of Superior dual-fuel diesel engines for gas or fuel oil operation.

WELDING

58 **WELDING SERVICE** — Lincoln Electric Co, 12818 Coit Rd, Cleveland 1, Ohio. 4-page service directory contains names and addresses of authorized Lincoln Electric field service shops.

59 **RODS AND FLUXES** — All-State Welding Alloys Co Inc, 273 Ferriss Ave, White Plains, N. Y. 32-page pocket-

NEW 40 Page Catalog of INTEREST



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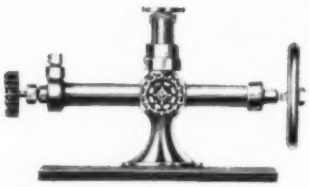

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size combination handbook and catalog lists all the All-State rods and fluxes, including several new items. Among the new products listed are a cutting electrode, a tinning rod and a sampler kit containing silver solder and ten other types of gas welding rods with appropriate fluxes.

60 WELDING FUME COLLECTORS—Ruemelin Mfg Co, 3860 N Palmer St, Milwaukee 12, Wis. 4-page bulletin No. 37-D discusses design and construction of Ruemelin welding fume collectors.

61 ARC WELDERS—Hobart Brothers Co, Hobart Sq, Troy, Ohio. 8-page booklet contains illustrations, descriptions, dimensions and specifications on complete line of Simplified arc welders.

62 GAS WELDING SUPPLIES—Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 16-page catalog describes 19 different gas welding rods, eight fluxes, and includes a section on silver brazing alloys, plus a page devoted to carbon rods and carbon plates.

63 WELDING ACCESSORIES — Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 15-page catalog covers both oxyacetylene and electric arc accessories, including goggles, hose, sparklighters, gloves, electrode holders, cable, weld cleaning tools, helmets, face shields and many other accessory items.

64 HARDSURFACING ELECTRODES—Lincoln Electric Co, 12818 Coit Rd, Cleveland 1, Ohio. Bulletin No. 469 gives applications for Lincoln hardsurfacing electrodes. Procedures for these electrodes are also included.

OTHER EQUIPMENT

65 PACK-HARDENING AND ISOLATING PASTES—Denfis Chemical Laboratories Inc, 172 Pacific St, Brooklyn 2, N. Y. New bulletin describes Carburit, a pack-hardening paste, and Isopac, an isolating paste.

66 WATER HEATERS—Davis Engrg Corp, 1064 E Grand St, Elizabeth 4, N. J. 6-page booklet No. 70, Section 1, features detailed capacity and dimension tables for 2-pass, 4-pass, and 6-pass designs of Paracoil instantaneous water heaters. Instructions for heater selection, engineering data to determine boiler capacities required for heating water, standard specifications, and a chart to determine pipe sizes for steam flow are likewise included.

67 INSULATION TESTERS—James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa. 4-page brochure No. 21-05-25 covers applications of ten different types of Megger insulation testers. A time saving selection chart and many practical hints for making the correct choice of an insulation resistance tester are also included.

68 BUSHINGS AND ADAPTERS — Dodge Mfg Corp, Mishawaka, Ind. Bulletin A-420 furnishes dimension tables and price lists of Taper-Lock bushings, adapters and weld-on hubs. Diagrams and illustrations are also given.

69 GAS PUMPS — Roots-Connersville Blower Corp, 900 W Mount St, Connersville, Ind. 16-page booklet No. 32-33-B-13 discusses rotary positive gas pumps. Illustrations of the four standard types now being offered, along with line drawings showing a longitudinal section of each type are included. Typical performance curves and other data are also carried.

70 CORROSION PROTECTION—Bird-Archer Co, 400 Madison Ave, New York 17, N. Y. 4-page folder, entitled "Corrosion Protection of Steam and Condensate Return Systems," describes the recently developed amine treatment.

71 LOAD MEASURING BEAM—Baldwin Locomotive Works, Testing Equipment Dept, Philadelphia 42, Pa. 2-page illustrated bulletin, No. 274, tells about the applications of SR-4 load beams, such as for process and machine control, and for general force measurement.

CONTROL

Scale and Corrosion in Power Plant Equipment

WITH

Newly Perfected

Water Conditioning Chemicals

Recently developed applications of the newer colloids and surface-active agents in Wright Chemicals for power plants result in **improved** water conditioning — **positive** scale and corrosion control. Wright Chemicals contain 100% soluble, available chemicals—no waste or inert matter—insuring increased operating efficiency and reduced cost.

Boiler Water . . .

Corrosion and scale-forming compounds in boiler water can be controlled with Wright Chemicals.

Steam and Condensate Lines . . .

Steam and condensate lines can be properly protected by using Wright recommended formulas.

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Efficiency of cooling jackets can be substantially increased by preventing corrosion and scale deposits on heat transfer surfaces.

Wright improved chemicals are the result of intensive study and research by men with years of experience in the development, production, application and control of water-conditioning chemicals.

Wright has no one cure-all to solve all problems. Each receives individual treatment. The Wright field engineer, who will call on you upon request, will obtain all necessary information and samples for examination in the modern Wright laboratory. Analyses are interpreted in view of supplemental information received, and recommendations made in the form of a proposal. Clients are provided with regular laboratory service as a periodic check upon conditions.

Send for new folder giving full details.

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Specializing in Water Conditioning
GENERAL OFFICES AND LABORATORIES
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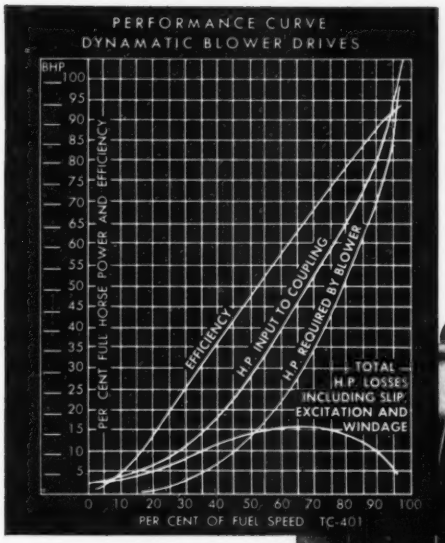
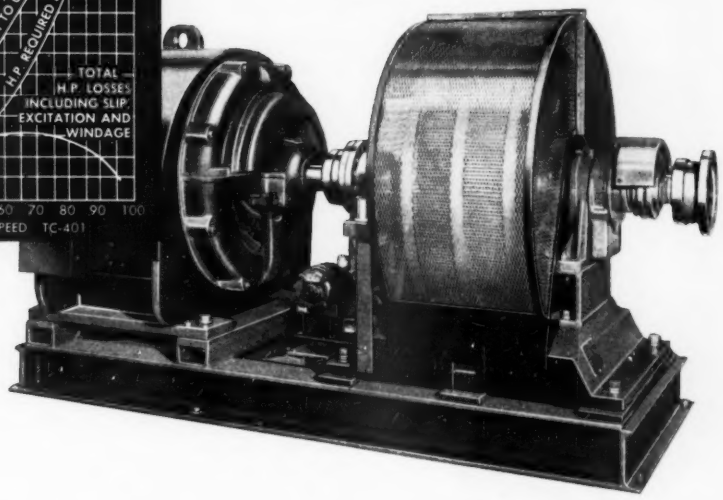


EATON DYNAMATIC BLOWER DRIVES



Instantaneous Response to Speed Control

Dynamatic Variable Speed Couplings are ideally adapted to such applications as regulating air drafts in steam generating stations, power house fan drives, public utility induced draft fans, and forced draft fans. Controls can be made to change the output speed of the coupling and hold that speed constant. Response is instantaneous and load changes are closely followed. The speed range available is practically infinite, and can be controlled precisely from ten per cent speed up to full speed.

The performance curve above indicates the characteristics of Dynamatic couplings when driving fans or blowers. Fundamentally, all fans and blowers will have curves very close to the ideal curves shown in this figure. Note the desirable relationship between efficiency, horsepower input, and required horsepower. The horsepower losses indicated are normal for this type of application. Both air cooled and water cooled types of Dynamatic couplings are available, selection depending upon loads and type of service involved. The electric-slip coupling was developed and introduced by Dynamatic; this company has pioneered the use of electric-slip couplings in fan and blower drive applications. Write for illustrated literature.

EATON MANUFACTURING COMPANY • CLEVELAND, OHIO
ADDRESS INQUIRIES TO: DYNAMATIC DIVISION • KENOSHA, WISCONSIN

PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITES SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS

You Need a KENNEDY Electrically Controlled Valve

Where manual operation is too lengthy or too difficult.

Where valve control is desired at a distant point, or at two or more points.

Where a group of many valves must be operated frequently.

KENNEDY furnishes electrically controlled valves, for standard and low pressure services and all standard A.C. and D.C. voltages.

The motor, reduction gearing and limit switches are fully enclosed in a weather-proof housing. Safe, dependable operation is secured through accurately set limit switch with torque seating and thermal overload protection.

Emergency manual operation provided. Handwheel does not turn while valve is operated electrically.

KENNEDY electrically operated valves are ready for use. Setting of limit switch, trial operation and hydrostatic test are all completed at the factory.

KENNEDY Fig. 611G., Top-mounted Electrical Control on Standard, Iron Body, Double-Disc, Gate Valve; Services up to 125 Steam, 175 pounds Water, Oil or Gas; 4" through 60" sizes available.

Check List for Use with Inquiries or Orders

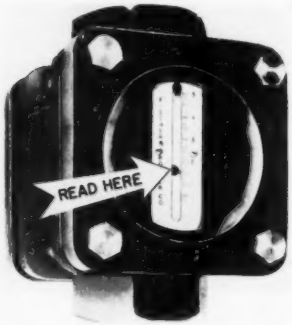
- ☐ Size of valve and whether O.S. & Y. or Non-rising Stem.
- ☐ Working or test pressure and actual unbalanced pressure on discs.
- ☐ Type connection; flanged, bell ends, or special.
- ☐ Position of valve in pipe line.
- ☐ Electric current characteristics; D. C. or A.C. voltage; phase, cycles if A.C.
- ☐ Number of control stations wanted.
- ☐ Brief description of installation; fluid or gas controlled, frequency of operation and function of valve.

Write for complete information. No obligation.

THE KENNEDY VALVE MFG. CO.
1060 EAST WATER ST.
ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS

OFFICE-WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

ductors up to 2-in. dia. Voltage measurements are made by connecting a set of clip-on leads between the line and set screw terminals on side of meter. Current and voltage measurements can be taken in quick succession by flipping selector switch to either amp or volt position. Jaws are insulated to prevent short-circuit when measuring current in bare conductors.
Weston Electrical Instrument Corp. 617 Frelinghuysen Ave, Newark 5, N. J.



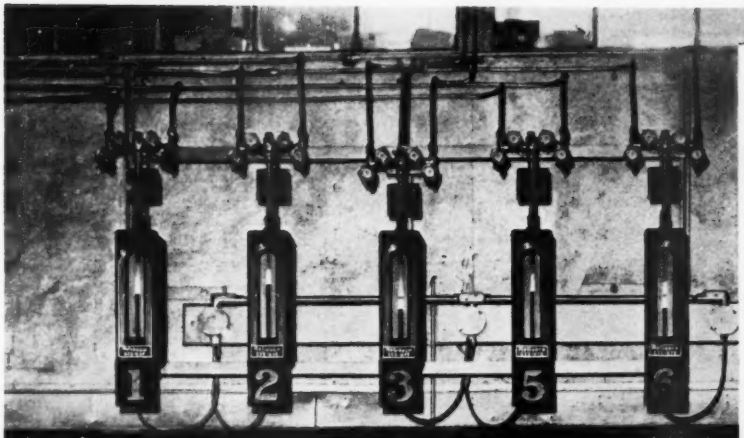
P747 • FLOW GUIDE *Magna-Sight* flow guide uses a bull's-eye body with a fixed diameter orifice at its vertical inlet. Unit measures maximum flow rates of 3.5 to 250 gpm.

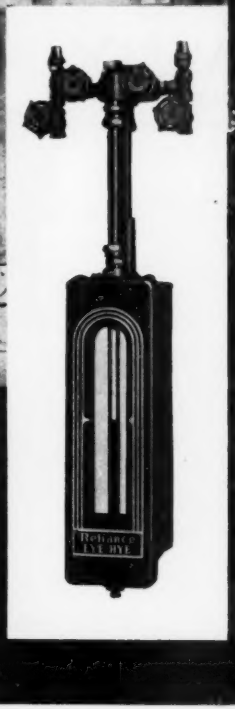
Minimum measurable flow rate for any given indicator is one-tenth of maximum. Unit can be made of iron, steel, brass, bronze and stainless steel. It is made in eight sizes from ¾ to 4 in. screwed or flanged.
Fischer & Porter Co, Hatboro, Pa.

P723 • FEED-IN-DUCT –Unique feature of this bus system is splitting of one phase on a three-phase job so the split-bus is positioned on either side of remaining two phases. Solid ebonized asbestos is used between and around the buses.

This construction permits close spacing and electrical symmetry, important in reduction of both energy loss and voltage drop. Duct may be used as service entrance from transformer banks to distribution centers, vertical distribution in multiple story buildings and low-drop transmission of large power blocks.
Square-D Co, 6060 Rivard St, Detroit.

P715 • FLEXIBLE COUPLING — An all-rubber-center coupling is designed for fractional horsepower motors. Flexing caused by misalignment is absorbed by en-





These 5 EYE-HYE Remote Reading Gages

are time-saving watch dogs for Bigelow-Sanford boilers

THERE'S small chance of overlooking *these* water level indicators. Reliance EYE-HYE, the hydrostatic remote reading gage, can be placed at any vantage point—mounted on panel board, girder, or wall—as are these five in the Amsterdam, N.Y. plant of the Bigelow-Sanford Carpet Company. They tell a true story of boiler water level position; greatly reduce climbing to high, hard-to-see drum gages; *eliminate danger of incorrect readings.*

EYE-HYE's brightly illuminated green indicating fluid reads like a conventional gage, only it's *clearer, faster, surer.* And hydrostatic operation means constant full-range accuracy; factory calibration eliminates adjustments on location. Complete temperature equalizing unit is furnished with each EYE-HYE.

For main boilers or any liquid containing vessels, EYE-HYE is the original trouble-free gage for dependable remote supervision. Easy to install—practically no maintenance. Nearly 9000 in use, on land and sea. Write for full information.

BOILER SAFETY DEVICES since 1884

Reliance

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THE
ALLPAX
GASKET CUTTER

Quickly pays for itself

Made by a packing manufacturer who knows the needs of packing users. This fast, convenient tool will save you time, money and material over the slow laborious sloppy method of cutting gaskets by hand. Gasket cutting is put on a production basis by the "ALLPAX". Cuts clean gaskets in any gasket material in diameters from 1" to 36", with any width flange. Pays for itself and effects savings every time it's used.

FREE TRIAL OFFER

For a limited time only, we will ship an ALLPAX Gasket Cutter for a 30-day trial at our expense. Write for details of this offer.

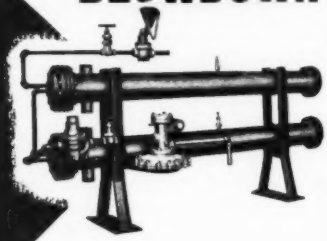
Complete . . . ready for use . . . packed in hardwood case with hinged cover. Equipment includes six (6) double-edge cutting blades and one (1) 18" varnished wood cutting board. Order NOW.

PRICE COMPLETE $19.50

THE ALLPAX CO., INC.
MAMARONECK, N. Y.

HENSZEY CONTINUOUS BLOWDOWN

Prevents **PRIMING**
Prevents **FOAMING**
Prevents **SLUDGE**
Prevents **SCALE**
(with simple chemical treatment)



AN INVESTMENT THAT PAYS 50% INTEREST

The Henszey System automatically keeps boiler water concentrations within safe margins. This is accomplished continuously WITHOUT HEAT LOSS. Maintain clean, efficient boilers for substantial savings in fuel, equipment and manpower.

HENSZEY

Consult your nearest HENSZEY Representative or write to

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CONTINUOUS BLOWDOWN and BOILER PLANT SPECIALTIES
Boiler Feed Regulators • Distillation Systems • Heat Exchangers
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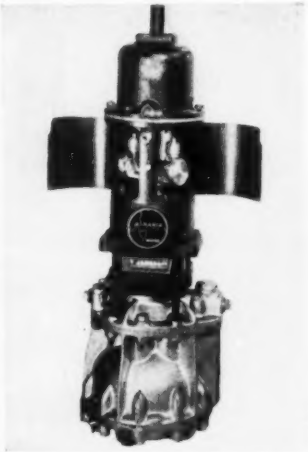
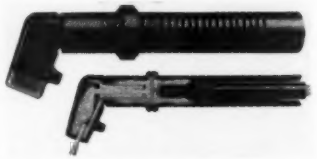
tire center member rather than by loose fit of pins.

Tight-fitting coupling pins eliminate noise and vibration when pressed into the rubber-center member. Among applications are home power tools, washing machines, pumps, fans, and dairy machinery.
Borg-Warner Corp, 310 S. Michigan Ave, Chicago 4, Ill.



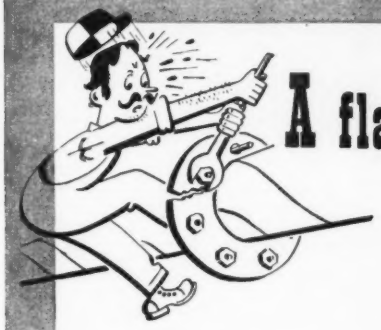
P748 • FLOW TRANSMITTER — Askania *Transometer* generates an air pressure signal from 2 to 15 psi to be used directly with present types of air-operated controllers. It translates liquid flows to low-pressure air signals for measurement and control purposes.

Combined with a positive-displacement meter, it converts rpm of the positive-displacement meter into an air-pressure signal proportional to square of liquid flow. Initial output pressure signal is adjustable over a range of 0 to 3 psi and the top output pressure signal over a range of 10 to 18 psi. Maximum input rpm may vary from 25 to 3000 or more. Tests show good results are possible down to 10% of the maximum rpm for which *Transometer* is designed.
Askania Regulator Co, 240 East Ontario St, Chicago 11, Ill.



P766 • INSULATED ELECTRODES— Special insulation material, *Lifeguard*, covering the gripping head of electrodes, permits depositing the full flux length of welding electrodes.

Insulation has a high resistance to impact and will not chip or crack. It possesses the ability to withstand the high temperatures put up by the direct heat of the arc in the last inch of electrode.
Bernard Welding Equip Co, 741-43 E 71st St, Chicago 19, Ill.



A flange broken 50 years ago...

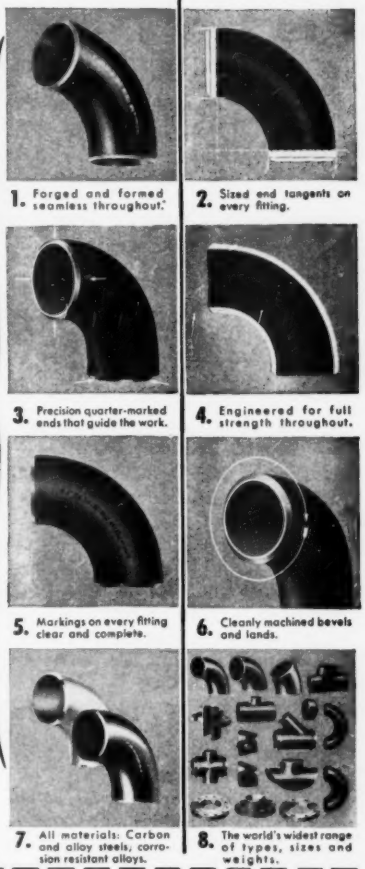
...led to one thing, to another, to another...

When Taylor Forge started up, way back, with spiral pipe it was our No. 1 item (still important). In those days cast iron flanges were largely used, and the troubles resulting from flange breakage were frequent and aggravating. The remedy for this major headache was found in the development of forged steel flanges; first for our own spiral pipe, later for our straight seam, and in fact any pipe; finally for general pressure vessel and industrial application.

That put us definitely in the forging business some forty years ago and was the start of a long pioneering journey into the field of engineered piping problems. The expanding needs of industry multiplied the response for larger, heavier, stronger, and tougher flange and ring forgings to which we reacted with new, heavier, and numerous units of forge, press, and rolling equipment. It was equally necessary to pioneer design methods, not only for flanges and pipe application, but for other pressure vessel components as well—so that almost automatically we became, and remain, the world's largest manufacturer of forged (or forge-rolled) steel flanges, welding necks, manways and nozzles, etc., for *any* application.

Then came rapid strides in the art of welding which quickly cancelled out the crude, cut-fit-patch methods first attempted in pipe systems. Again we found it necessary to *engineer* the design of suitable components. Several years of research preceded the development of the *full*, engineered line of Taylor Forge welding fittings—the well-known WeldELL line. Examine the illustrations to the right, and note how many unique features combine good engineering with good sense and ultimate economy. The coupon below is the convenient means for getting more information about the fittings that have "Everything."

WeldELLS have everything



1. Forged and formed seamless throughout.
2. Sized end tangents on every fitting.
3. Precision quarter-marked ends that guide the work.
4. Engineered for full strength throughout.
5. Markings on every fitting clear and complete.
6. Cleanly machined bevels and lands.
7. All materials: Carbon and alloy steels, corrosion resistant alloys.
8. The world's widest range of types, sizes and weights.

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TAYLOR FORGE & PIPE WORKS General Offices & Works: Chicago 90, Ill. (P.O. Box 485). Eastern Plant: Carnegie, Pa. Western Plant: Fontana, Calif. • District Offices—New York: 50 Church Street • Philadelphia: Broad Street Station Bldg. • Pittsburgh: First National Bank Bldg. • Chicago District Sales: 208 S. LaSalle Street • Houston: City National Bank Bldg. • Los Angeles: Subway Terminal Bldg.

Please send a copy of your new catalog 484 covering welding fittings and forged steel flanges.

Name_____

Position_____

Company_____

Street address_____

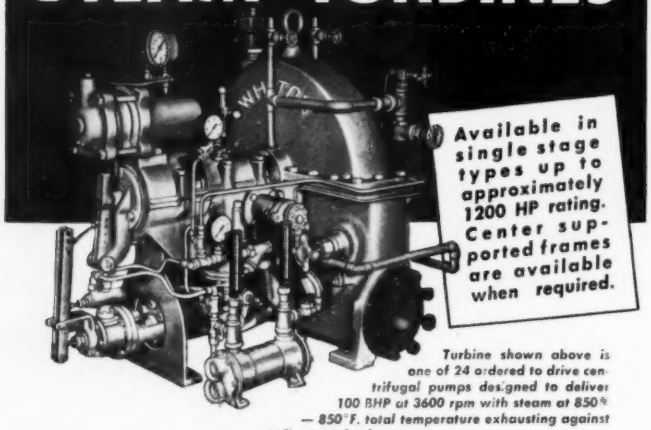
City_____ Zone_____ State_____

Mail to Taylor Forge & Pipe Works, P.O. Box 485, Chicago 90, Ill.

501-0749

Whiton SOLID STEEL ROTOR

STEAM TURBINES



Available in single stage types up to approximately 1200 HP rating. Center supported frames are available when required.

Turbine shown above is one of 24 ordered to drive centrifugal pumps designed to deliver 100 BHP at 3600 rpm with steam at 850# — 850°F. total temperature exhausting against 42# gauge back pressure.

• SIMPLE DESIGN FOR ACCESSIBILITY

Inlet and exhaust connections are located in lower half of casing which is horizontally split to allow easy access to all internal parts. Rotating unit including bearings and governor head may be removed without disturbing alignment of the unit.

• RUGGED CONSTRUCTION FOR RELIABILITY

Whiton rotors are made from a solid steel forging with semi-circular buckets milled in the rim to give strength where it is needed. End thrust is minimized because the path of the steam is always at right angles to the shaft.

• SAFETY DEVICES FOR TROUBLE-FREE OPERATION

Standard equipment includes Constant Speed Governor with V-Ported Governor Valve . . . Emergency Governor with Independent Valve . . . Steel Plate Steam Strainer . . . Two oil rings per bearing supplemented by water cooling . . . Sentinel Type Casing Relief Valve . . . Additional accessories available as required.

THOUSANDS OF SATISFACTORY INSTALLATIONS SINCE 1911

Write for complete information

Whiton Since 1856

WHITON MACHINE COMPANY

NEW LONDON, CONN., U.S.A.

also makers of Fine Lathe Chucks • Gear Cutting Machines • High Production Milling Machines • Centering Machines

The 1948 James Turner Morehead Medal of International Acetylene Assn has been awarded to Herman Van Fleet of Air Reduction Co, New York 17, N. Y. Van Fleet received the medal in recognition of his leadership and direction in production of acetylene and oxygen, and in development of equipment for their use. The medal was presented to Van Fleet during opening session of the convention of *International Acetylene Assn*, held at Hotel William Penn in Pittsburgh on April 25 and 26.

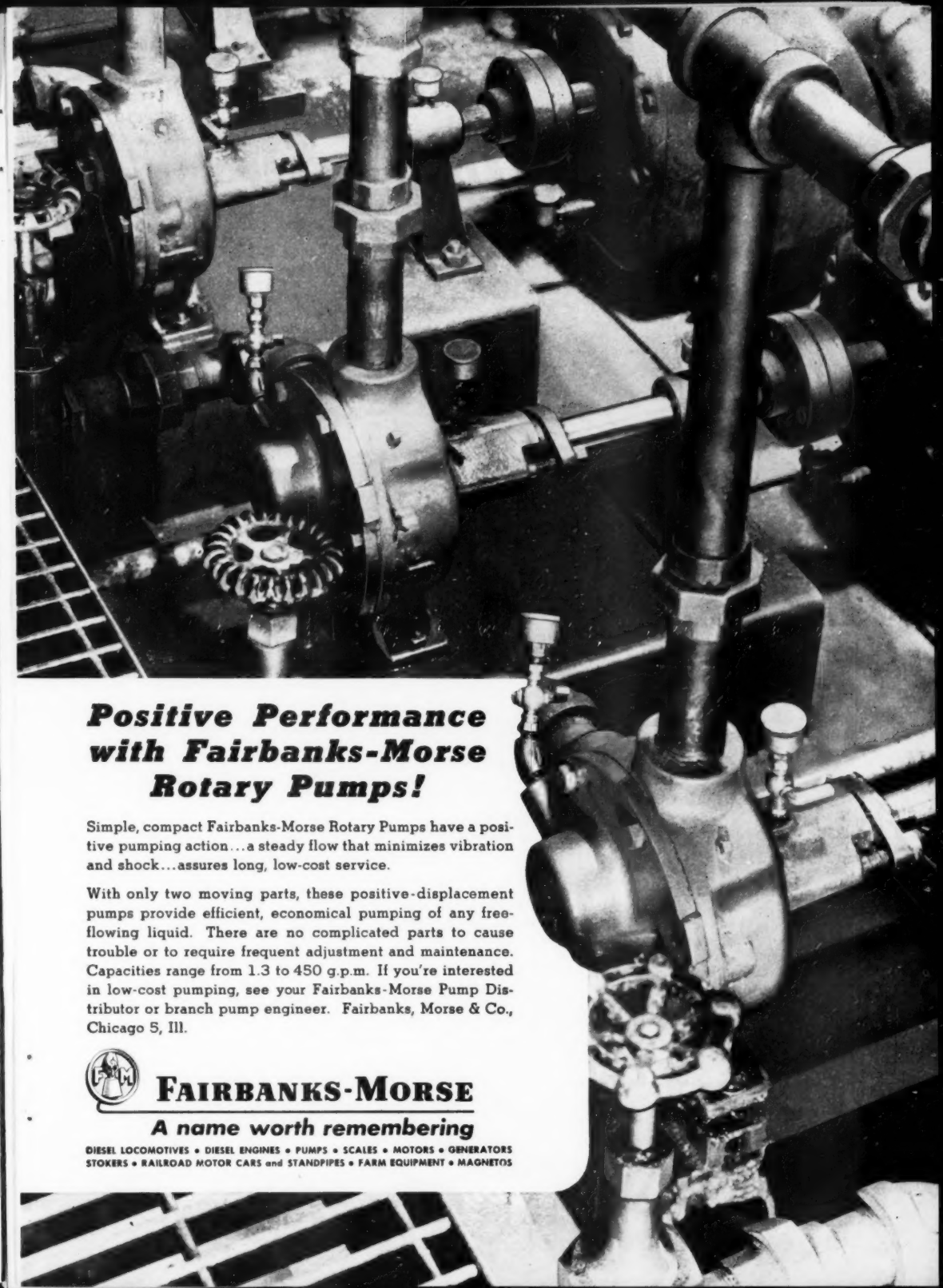
Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y., manufacturers of compressed industrial gases, welding supplies and equipment, has announced a new oxygen and acetylene cylinder leasing plan designed for the small-volume user. Airco has "teamed up" a 122-ft capacity oxygen cylinder with a 60-ft acetylene cylinder and is offering them on lease for a 25-year period at $50 per pair. This 25-yr period is the estimated life of the cylinders.

A new sound motion picture, entitled "Underground Arteries—The Story of Transite Pipe," has just been completed by Johns-Manville and is now ready for distribution. It is in full color and the showing time is 32 min. Arrangements for showings of this picture can be made by writing to *Johns-Manville, 22 E 40th St, New York 16, N. Y.*

Caterpillar Tractor Co, Peoria, Ill., has dedicated, and geared for full production, its new engine factory. This is the first major milestone in Caterpillar's post-war expansion program. Devoted exclusively to manufacture of diesel engines to power the company's track- and wheel-type tractors and motor graders and to serve as well as stationary power units, the building permits integration of manufacturing processes and expansion of facilities in older areas of the Peoria plant.

Magnesia Insulation Manufacturers Assn has published a 96-page manual, illustrated with line drawings and photographs, that will be available this month to those having a direct interest in industrial heat insulation. Among the subjects covered are: the properties of 85% magnesia, determination of correct thicknesses, application and finishing procedures, and insulation maintenance. The appendix contains a discussion of practical applications of heat-transmission theory, definitions of technical terms, 15 tables of data on 85% magnesia and related subjects, a glossary of trade terms, and a list of trade names of insulating material and accessory products. Requests for copies should be made to the Association, 1317 F St, N W, Washington 4, D. C., on business letterhead, giving title of the individual making the request.

Allis-Chalmers Mfg Co, of Milwaukee, Wis., submitted a low bid of $3,542,010 to the Corps of Engineers at Walla Walla, Wash., for design and manufacture of three hydraulic turbines for proposed Ice Harbor Dam on the Snake River, according to Col William Whipple, district engineer. No fabrication will be initiated until funds are made available by Congress.



Positive Performance with Fairbanks-Morse Rotary Pumps!

Simple, compact Fairbanks-Morse Rotary Pumps have a positive pumping action...a steady flow that minimizes vibration and shock...assures long, low-cost service.

With only two moving parts, these positive-displacement pumps provide efficient, economical pumping of any free-flowing liquid. There are no complicated parts to cause trouble or to require frequent adjustment and maintenance. Capacities range from 1.3 to 450 g.p.m. If you're interested in low-cost pumping, see your Fairbanks-Morse Pump Distributor or branch pump engineer. Fairbanks, Morse & Co., Chicago 5, Ill.

FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • PUMPS • SCALES • MOTORS • GENERATORS
STOKERS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS

Readable ON THE RUN!

Weston
ALL-METAL
Thermometers

Only a glance is necessary to read the WESTON wide open, bold-faced dial . . . accurately. This readability, combined with rugged, all-metal construction, assures long-time dependability. There's a WESTON thermometer for most industrial applications . . . in a wide variety of types, stem lengths and scale ranges. Call your jobber, your local WESTON representative, or write for Thermometer Catalog . . . WESTON Electrical Instrument Corporation, 637 Frelinghuysen Ave., Newark 5, New Jersey.

CONTACT MAKING models for alarm or control purposes.
MAX-MIN models to indicate highest or lowest temperature reached.

WESTON Instruments

APPOINTMENTS

Westinghouse Electric Corp names the following directors for 4-year terms: G H Bucher, Westinghouse vice-president; A W Page, industrial consultant, New York City; W C Robinson, president, National Electric Products Corp, Pittsburgh; and R T Swaine, partner in law firm of Cravath, Swaine & Moore, New York City. Roscoe Seybold, Westinghouse vice-president, becomes director for 3-year term, and Edward Hopkinson Jr, partner in Drexel & Co, Philadelphia, for 1-year term.

The following personnel changes are also announced by **Westinghouse:** H E Dralle succeeds S L Henderson who retired July 1 as Eastern engineering and service manager. Dralle will be located in the New York office. D E Inman is transferred to Northwestern engineering and service div as manager replacing H K Smith, retired. Inman will be in the Chicago office. M L Gardner succeeds Inman as engineering manager, district engineering and service dept, East Pittsburgh works.

General Electric Co has made several appointments as follows: William R Wright has been assigned to Atlantic district as representative for wiring devices, wire and cable conduit products. He will cover wholesale and trading area of Lancaster, Pa. Elmer K Stieglitz has been named full-line representative for the Southeastern district, handling the Knoxville, Tenn. area. Frank C Neal Jr has become manager of distributor sales div of GE's welding divisions. He will make his headquarters at Fitchburg, Mass. Preston D Morgan succeeded Neal as manager of GE Houston welding div. W F Rauber has been appointed manager of sales for switchgear divisions, apparatus dept, at Philadelphia, succeeding J D Hoffman who has assumed duties of sales manager for air conditioning and commercial refrigeration div, air conditioning dept, Bloomfield, N.J.

A P Olches is promoted to chief engineer of **Peabody Engrg Corp,** New York City. He continues to direct engineering and research for the firm.

Allis-Chalmers names Carter B Hart New England region dealer supervisor. The New England territory embraces offices in Boston, New Haven and Providence.

Bornell Supply Co, 180 E Main St, Piqua, Ohio, is chosen distributor of Hewitt industrial rubber products in Piqua and surrounding territory for **Hewitt-Robins Inc.** Also, appointment of two sales representatives to handle mechanical rubber products for Hewitt Rubber div are as follows: Thomas P McNeish will cover Los Angeles territory and Hall S Derkin will be located in Chicago.

Reliance Electric & Engrg Co transfers additional field sales application engineers to ten of the company's sales offices as follows: Byron O Lutman—Detroit; Robert C Suttle—Cincinnati; Wil-

- COMPACT - SIMPLE - RUGGED
- WELL-BALANCED ENGINEERED DESIGN WITH BUILT-IN INHERENT STABILITY
- FORCE BALANCE TYPE OF POSITIONER
- AVAILABLE WITH AND WITHOUT BY-PASS
- USEABLE AS REMOTE POSITION INDICATOR

FOR COMPLETE SPECIFICATIONS AND DETAILS, WRITE FOR FISHER BULLETIN E-3500.

FISHER GOVERNOR CO., Marshalltown, Iowa

Jefferson

Malleable Iron Air-Tested

FLANGE UNIONS

Assure Maintenance Savings

High tensile strength, accurate machining and rigid inspection assure highest quality and maximum performance.

Jefferson Flange Unions, like all Jefferson Unions, feature the Recessed Brass Seat. This metal-to-metal spherical contact seat is located in a recess away from the runway of the fitting and screwed pipe ends cannot come in contact with it. Furthermore, this design assures unrestricted flow and low maintenance.

Complete details available promptly from your nearest distributor or from us direct.

JEFFERSON UNION CO.

605 W. 26th St., New York 1, N. Y.

63 Gooding St., Lockport, N. Y.

39 Fletcher Ave., Lexington 73, Mass.

SOUNDS OFF WHEN THERE'S TROUBLE!

SERIES 300

PANALARMS

THE UNIVERSAL SAFE MULTIPLE UNIT SIGNAL

LIGHTS UP TO SHOW WHERE!

ADAPTED TO
- **Flush Mounting**
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FOR MAXIMUM VISIBILITY

A new conception in Industrial Signal Systems—flexible, interchangeable units that convert speedily into ideal sound-and-visual alarms with a broad range of applications for Process Work, Power Plants, etc.

The same basic PANALARM unit makes possible Safety Shutdowns, Sequencing, or Interlocking of Plant Operations. Design is never frozen when you specify PANALARMS!

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PANALARM PRODUCTS, INC.

7210 N. Clark St., Chicago 26

A SUBSIDIARY OF PANELLIT, INC., MANUFACTURERS OF PREFABRICATED CONTROL SYSTEMS

liam H Chambers—Syracuse; Robert L Potter—Pittsburgh; William B. Maley—New York; Eugene H Sowers—Philadelphia; J Robert Zahn—Cleveland; Robert Magnetti—Chicago; and Robert B Reed—Birmingham, Ala. Also, Clyde F Giegel joins Pittsburgh office as field service engineer and Albert M Cherry moves to Rockford, Ill. sales office.

Sales representatives in various states are selected by **Vulcan Soot Blower Corp** as follows: Johnson-Heyck Inc, 425 West Bldg, Houston 2, Texas; J A Carter, 412 E 5th Ave, Knoxville, Tenn.; Hoshall Machy Co, Columbian Mutual Tower, Memphis, Tenn.; H A Schlieder, 520 Robineau Rd, Syracuse 7, N. Y.; Laney Co, Kennedy Bldg, Tulsa, Okla.; Heckeroth Engrg Sales Co, Homewood Sta, Birmingham 9, Ala.; and Marine Specialty Co, 6-12 S Water St, Mobile, Ala.

Combustion Engrg-Superheater Inc, New York City, announces following appointments in its sales dept: Walter Springe is now division manager with headquarters in Kansas City, Mo. C J Grossi and W J Woodruff are district managers in Tulsa, Okla. and St. Louis, Mo. offices, respectively. T E McMahon is transferred to Kansas City, Mo. as district manager.

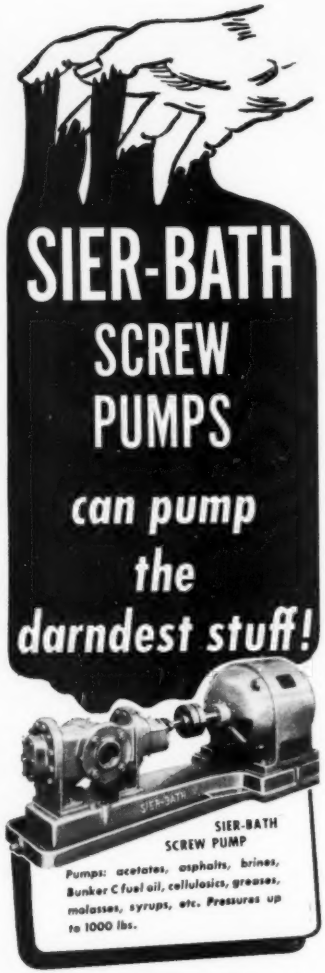
Power chemicals div of **E F Drew & Co,** New York City, has added Vincent P Murphy to its technical dept, and John W Wood to the research dept. Both men will carry out work in connection with expansion of this division.

Frederick Boehm is promoted to chief engineer for **Schutte & Koerting Co,** Philadelphia, Pa. In addition, Frederick L Seibold becomes sales manager.

Elgin Softener Corp, Elgin, Ill., names the following sales representatives: Arthur Weber, with headquarters in McKerchey Bldg, Detroit, for Michigan; Guy Mankin with offices in First National Bank Bldg, Atlanta, for Georgia; and C Donald Kopplin in Minnesota, North and South Dakota, and northwestern Wisconsin with headquarters at 5629 Nicollet Ave, Minneapolis.

Allan Craig is being transferred to Houston, Texas, as general manager of southwestern div of **Link-Belt Co.** Michael J Perry succeeds Craig as sales manager of southeastern div, with headquarters at the Atlanta plant. Andrew K Kolar becomes district manager in charge of Moline, Ill. office. Also, Newark, N. J. office of Link-Belt is now at 212 Essex Bldg. John D Riley replaces George E Ramsden, who died April 10, as district manager at Newark.

Norton Co has established a new district in the St. Louis, Mo. area in charge of R O Anderson, district manager. This district will include territories which previously composed the Rocky Mountain and South Central districts, and two areas formerly in the Chicago district. H G Brustlin has been appointed abrasive engineer in charge of the Denver territory and will make his headquarters there. He will report to Anderson. Another area



No matter how gooey the stuff, it can't "gum up the works" in a Sier-Bath Screw Pump. The powerful thrust of its screw moves materials so viscous that they are often in a semi-solid condition.

The simple design (only two moving parts) and accurate but sturdy construction, make these screw pumps long-lived and keep them relatively free of maintenance. They are available in horizontal and vertical models. Send for booklet.

ALSO MANUFACTURERS OF SIER-BATH GEAREX ROTARY PUMPS AND SIER-BATH PRECISION GEARS

FOUNDED 1905 **MEMBER A.G.M.A.**

Sier-Bath

GEAR and PUMP CO., Inc.

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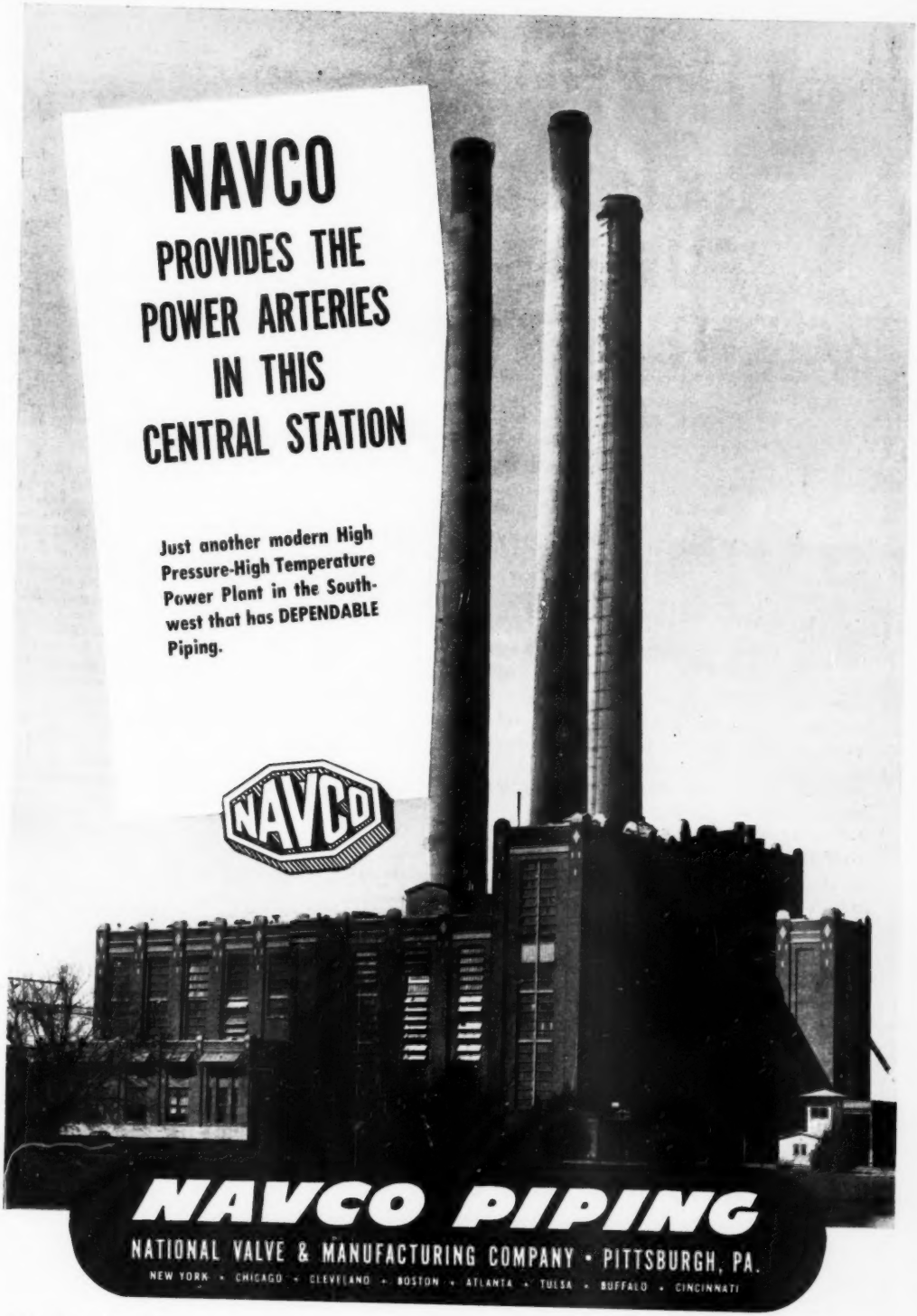
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Just another modern High Pressure-High Temperature Power Plant in the Southwest that has DEPENDABLE Piping.
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NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.
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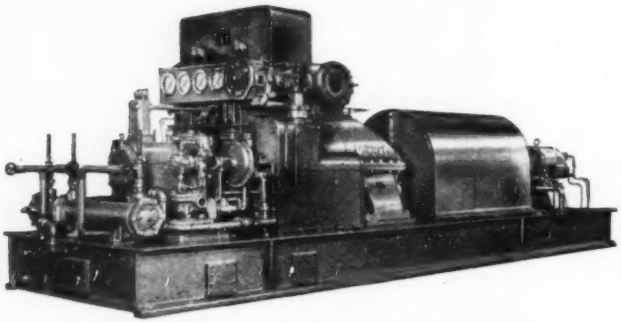
MURRAY
TYPE D TURBO-GENERATOR



Murray Type D turbo-generators are built in a capacity range from 500-3000 KW. Turbines are either direct-connected to 2-pole generators or operate through reduction gears connected to 6-pole generators at 1200 RPM. Direct current and 25 cycle machines are also available. This type machine is regularly furnished in the above capacity range either condensing or non-condensing and may be of the automatic extraction type or for high back pressure. Units may be mounted either on soleplates or on a fabricated steel base.

This type turbo-generator is designed to operate on steam conditions up to 600#, 750° F. TT. Auxiliary equipment normally includes combined trip throttle valve, complete pressure lubrication system including oil tank, oil filter, coolers, and automatic turbine-driven auxiliary oil pump. Gauge board with gauges, vibrating reed tachometer and necessary thermometers are also furnished.

The above photograph shows a machine of this type rated at 1000 KW. Two duplicate machines are installed in our Nation's Capitol.

Murray turbo-generators have long been noted for their rugged construction, operating economy and long life with a minimum of maintenance.

WRITE TODAY FOR FULL DETAILS

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT
FOR THREE QUARTERS OF A CENTURY

called the Central region has been added. It will include territory around Cleveland and Detroit formerly part of Eastern and Western regions, respectvely. Donald L Price has been appointed sales manager of Central region, and is succeeded by William A Russel as Detroit district manager.

Norton's Eastern region, now to include the New England, Philadelphia and Pittsburgh districts, remains under supervision of George A Park, sales manager. W Earle Shumway continues as sales manager of Western region.

Robert E Marshall is named secretary of **Worthington Pump & Machy Corp,** Harrison, N. J., succeeding the late C Neal Barney. Marshall's headquarters will be at 2 Park Ave, New York City. Also, James W Hepburn is now assistant manager of vertical turbine pump div. He will make his headquarters at the firm's Denver works where he will be responsible for customer relations in territories west of the Mississippi River, including Chicago, St. Paul and New Orleans.

Youngstown Sheet & Tube Co, Youngstown, Ohio, promotes Lew E Wallace to general manager of sales. He will have Jay W Owings and Myron H Watkins as his assistants. Wallace fills the vacancy created by death of Charles H Longfield.

John W Humphrey has been elected president of **Phillip Carey Mfg Co,** Cincinnati, Ohio. Humphrey succeeds Robert S King, who has become chairman of the board replacing George A Rentschler who will continue as chairman of executive committee. L W Clarke has been elected vice-president in charge of sales. He takes over duties of F W Smith who resigned.

Canton Stoker Corp appoints the following representatives: Globe Machy & Supply Co, E First & Court Ave, Des Moines, for state of Iowa; Holsclaw Equip Co, 715 Richards St, Charleston, W. Va., to serve southern West Virginia and western Virginia; Lamb Engrg Co, 530 N Charles St, Baltimore, Md., to cover territory of Maryland, northern Virginia, and District of Columbia; E C Scholler, Western Savings Fund Bldg, Philadelphia, Pa., to handle southern Pennsylvania and Delaware.

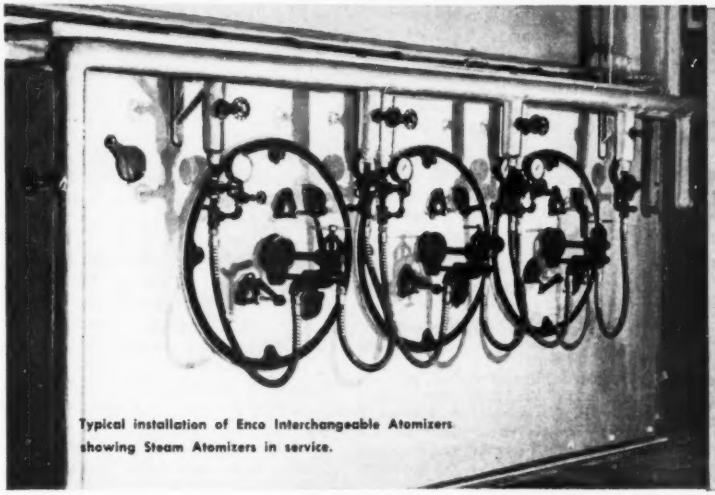
Engineering, sales and servicing of **Esterline-Angus** recording instruments and associated products in the Seattle region has been taken over by Eicher & Co, 263 Coleman Bldg, Seattle 4, Wash.

C A Dunham Co, Chicago, Ill., re-elected its board of directors and added two more. The new men are L D Mandell, vice-president, and Lewis C Murtaugh, secretary, of the company. General offices are now in the new building of the Michigan City plant. Administrative offices remain in Chicago.

Cutler-Hammer Inc, Milwaukee, Wis., names K M Nelson industry specialist. Nelson's duties will involve surveying the over-all requirements of machine tool and

It takes 5 ordinary atomizers to match the performance of the

ENCO WIDE RANGE Mechanical Atomizer



Typical installation of Enco Interchangeable Atomizers showing Steam Atomizers in service.

A complete line of gas and liquid fuel burners are designed and built by ENCO to meet the wide range of capacity requirements of steam plants, refineries, kilns and industrial process furnaces. Two of these are:

ENCO Steam Atomizing Oil Burner

ENCO Standard Mechanical Atomizing Oil Burner

All types of ENCO Atomizers are interchangeable quickly and easily.

Designed to minimize operating troubles in either full load or ignition service, the Enco wide range mechanical atomizer will handle a capacity of 10 to 1 . . . without changing burner tips when using 300 psi oil pressure. This equals the performance of *five* ordinary atomizers.

Now used in many power plants throughout the country, the Enco wide range mechanical atomizer maintains a more constant velocity of oil through the atomizer, and utilizes the high oil pressure to insure efficient atomization over the entire load range. Large or small boilers can be brought on the line and carried up to full load operation without changing sprayer plates.

The Enco wide range mechanical atomizer can be controlled manually by a simple twist of the hand-wheel or automatically by a remote control or combustion control system. It is built to give most economical, efficient service for any type of pulverized coal, gas, or oil-burning register as well as for stoker-fired and industrial type furnaces.

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Linings for

STEEL BUNKERS •
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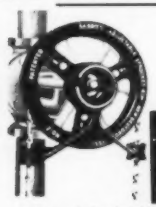
Branch Offices: New Orleans, Dallas, Denver.

"See our catalog in Sweet's"

NOW! All Overhead Valves are Instantly Accessible



with the LOW-COST

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

• Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

• Overhead valves—no matter how high up, or in whatever hard-to-get-at location—are instantly accessible from the floor! Operation of valves is quick, easy, positive and safe with the BABBITT Adjustable Sprocket Rim with Chain Guide. No more climbing on bench, machine, boiler or treacherous stepladder; no time-wasting.

• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

air-conditioning fields and making recommendations on the basis of a composite of those requirements.

E E Baker is now vice-president of public works pump div of **Hamilton-Thomas Corp,** Hamilton, Ohio. W G Rosendahl becomes vice-president of machine tool div.

Harold W Faint succeeds Jack F Brossart as general sales manager of **Industrial Filter & Pump Mfg Co,** Chicago, Ill. Brossart is now Pacific Coast manager.

Kieley & Mueller Inc, has chosen Van Hala Industrial Sales Co, 1051 Power Ave, Cleveland 14, Ohio, as its exclusive sales representative in the Cleveland area.

Harold J Zilske joins **Parker Appliance Co** as sales engineer in the Philadelphia area. He will handle application engineering of Parker components for hydraulic and fluid handling systems.

Lincoln Electric Co Cleveland, Ohio, has elected the following additional members to its board of directors: G F Clipsham, assistant to the president; William Irrgang, director of plant engineering; and L K Stringham, director of welding development.

An office has been established by **Okonite Co** at 1505 Tower Petroleum Bldg, Dallas, Texas, with Otis W Herring as manager, under supervision of the Birmingham district. Herring will have Sam K Dick, sales engineer, as his assistant. Also, the following men have been elected vice-presidents: I W Borda, manager, Pacific Coast district; W R Van Steenburgh, manager, North-East sales district; and Stephen A Wilson, secretary and general counsel.

Frank B Kreider is now Eastern and Mid-Western regional manager of Pabco's insulation div with headquarters at **Paraffine Cos'** offices, 295 Fifth Ave, New York City.

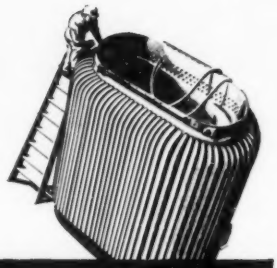
Perfex Corp, Milwaukee, Wis., promotes Douglas L De Vos to Chicago regional manager of its Controls div. Likwise, B F Werb becomes West Coast regional manager with offices in San Francisco, Calif.

John E Menz assumes duties of product manager, electrical conductor, directing sales of Kaiser aluminum cable and other products at **Permanente Metals Corp's** new plant in Newark, Ohio.

Walsh Refractories Corp, St. Louis, Mo., names James L Crawford president of the concern. N S C Walsh, retiring president, becomes honorary board chairman.

J H Ferguson has been made district manager of **Bristol Co's** branch office in Akron, Ohio. His headquarters will be at 727 Grant St.

Magnetrol Inc announces changes in its product distribution organization as follows: Cochrane Steam Specialty Corp, 80 Federal St, Boston, covers territory of



higher flow rates FOR transformer cooling coils

PROBLEM: Scale formations impeding water flow in copper coils of 10,000 kva oil transformers, 1900 gals. oil each.

DESCALING COMPOUND: Oakite Compound No. 32, fast, thorough, scale-dissolving agent . . . scientifically inhibited for maximum metal protection.

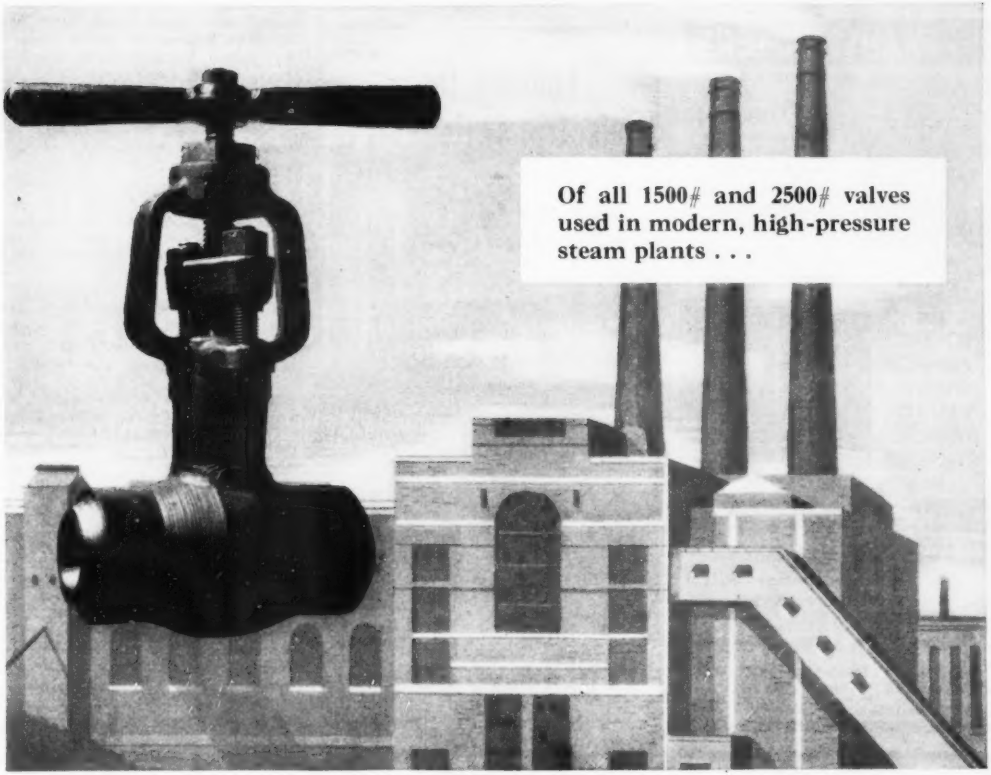
CLEANING EQUIPMENT: Acid resistant pump, hoses, rubber-lined solution drums.

RESULTS: Specially engineered Oakite descaling - by - circulation technique shaved hours off previous descaling time. Oakite alkaline neutralizing further protected copper cooling coils after acidic circulation. Water flow rates in each coil importantly increased.

YOUR equipment pressures, temperatures, flow rates should be watched for indications of scale accumulations. Condensers, heat exchangers, rectifiers, regulators require planned Oakite maintenance cleaning and descaling. Consult Oakite today, or write for full free data in the "71" Digest. No obligation.

OAKITE PRODUCTS, INC.
18C Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**
MATERIALS • METHODS • SERVICE



. . . Over 85% are Hancock

Hancock Steel WELDVALVES are the top choice of design and operating engineers in the country's high-pressure steam plants.

And this overwhelming selection of Hancock WELDVALVES is based on facts—not fancy.

Hancock's modern, functional design eliminates three possible leakage points—bonnet joint, gaskets and seat inserts. The seating surfaces are of super-hard stellite and are integral with the WELDVALVE body. This means years of trouble-free seat efficiency, extra long-life tightness. Test and field operating experience since 1935 indicates that *seat and disc life is permanent!*

Assembled by the most modern welding techniques, the lightweight component parts result in *tougher, huskier yet lighter valves.* The results are savings in space and lagging costs.

Service ratings up to 2500#—1050° F., W.S.P. and 6000#—100° F., O.W.G. Sizes ¼" through 2". Specify or replace with Hancock WELDVALVES. They will outlast the boilers and lines.

Available through leading distributors everywhere.

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

HANCOCK *Valves*

1877 HANCOCK U.S.A.

A PRODUCT OF

MANNING, MAXWELL & MOORE, INC.

WATERTOWN 72, MASSACHUSETTS

Makers of 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves and 'American' Industrial Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

TRANSFORMERS

STANDARD & SPECIAL

From ¼ to 400 KVA
up to 15,000 volts
We manufacture a
complete line of:
*AIR, OIL OR
WATER-COOLED
DISTRIBUTION
TRANSFORMERS

*Special Designs available to meet Customers' Specific Requirements

TRANSFORMERS
FOR
*ELECTRIC
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POWER & LIGHT
TRANSFORMERS

For isolation of Light from Power, or Light from Telephone

EISLER TRANSFORMERS are manufactured strictly to Standards of the N.E.M.A., A.S.A., and A.I.E.E.

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EISLER ENGINEERING CO., INC.
Chas. Eisler, Pres.
757 South 13th Street, Newark 3, N. J.

Looking for electric switches?

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You'll find them in your POWER Buyer's Guide Issue.

Power engineers everywhere are using their Buyer's Guides to find equipment of every description needed for efficient and economical power system operation.

The Buyer's Guide tells you *what is available, who makes it, where to buy it.*

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Keep and use your copy of the

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GENERAL INDUSTRY
CHEMICAL & PROCESSING
OIL FIELDS
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POWER PLANTS

Wherever piping dependability is a MUST...

CATAWISSA VALVES ARE THE ENGINEER'S PREFERRED CHOICE FOR TROUBLE-FREE SERVICE, MINIMUM MAINTENANCE COSTS!

LOOK AT THE ECONOMY HERE!

Eliminate the usual additional union and nipple on either outlet or inlet end of the line!

Double Extra Heavy Hot Forged Steel SWING CHECK VALVES

Pipe union type, especially adapted for high temperatures, extreme high pressure service, corrosive and acid conditions. Designed for perfect freedom of movement, with 100% opening. Stainless steel flapper and assembly, forged steel integral seat.

Recommended for . . .
600-lbs. Working Steam Pressure
1500-lbs. Oil, Water or Gas
Tested to 4000-lbs. NSHP

write for your copy of Bulletin 10-A

CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PA.

HOT FORGED STEEL STAINLESS STEEL
UNIONS

Massachusetts, Rhode Island, Maine, New Hampshire, Vermont and part of Connecticut; Berkley Engrg & Equip Co, 2417 Riverside Drive, Los Angeles, serves Arizona, Nevada, Los Angeles area and southern part of California; and Johnson Engrg Co, 534 20th St, Oakland, Calif., will handle trade in northern half of California.

Ray Oil Burner Co, San Francisco, elects Russell C Westover Jr to succeed Mrs R C Ray who is retiring from active management although remaining as a director of the firm.

Herbert B Reynolds, retired from New York City Transit System, has become associated with **J G White Engrg Corp,** New York City, consulting engineers.

Byrne Associates Inc, engineers, announce removal of their offices to 50 Broadway, New York, N. Y.

William E O'Brien joins **Fraser, Brace & Co,** New York City engineers and consultants. He will be associated with Harry Englander, general manager. O'Brien is also retained as consultant on the atomic energy installation at Brookhaven, L. I., until completion of that project.

Jefferson Chemical Co, New York City, promotes Harry M Mitchell to chief engineer replacing G R Wick, who is now assistant to the production manager.

R J Newell, director of Reclamation Region I—Columbia River Basin, retired July 1. He is succeeded by Harold T Nelson.

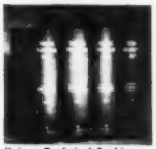
Bureau of Mines appoints Dr Milton H Fies, Birmingham, Ala., as consulting engineer to the office of synthetic liquid fuels. He also continues in his present position as part-time manager of coal operations for Alabama Power Co.

F W Russell has been made vice-president in-charge-of operations of **Louisville Gas & Electric Co,** succeeding the late Addison W Lee. A G Rosenbaum has replaced Russell as general superintendent. Likewise, F B Tetzel has become superintendent of steam production dept succeeding Rosenbaum.

Western Society of Engineers elects Gustav Egloff, petroleum technologist and director of research for Universal Oil Products Co, Chicago, to presidency of the organization. Other officers elected are: *First vice-president*—H P Sedwick, vice-president, Public Service Co of Northern Illinois; *second vice-president*—J C Witt, consulting engineer, Chicago; *treasurer*—Donald N Becker, chief structural engineer, A J Boynton & Co. Trustees for three years are Ludwig Skog, senior partner, Sargent & Lundy, and I. F Bernhard, cost study engineer, Illinois Bell Telephone Co. The society now has new headquarters at 84 E Randolph St, Chicago, Ill.

American Supply and Machinery Manufacturers' Assn has chosen Ralph M Johnson, vice-president in-charge-of

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.



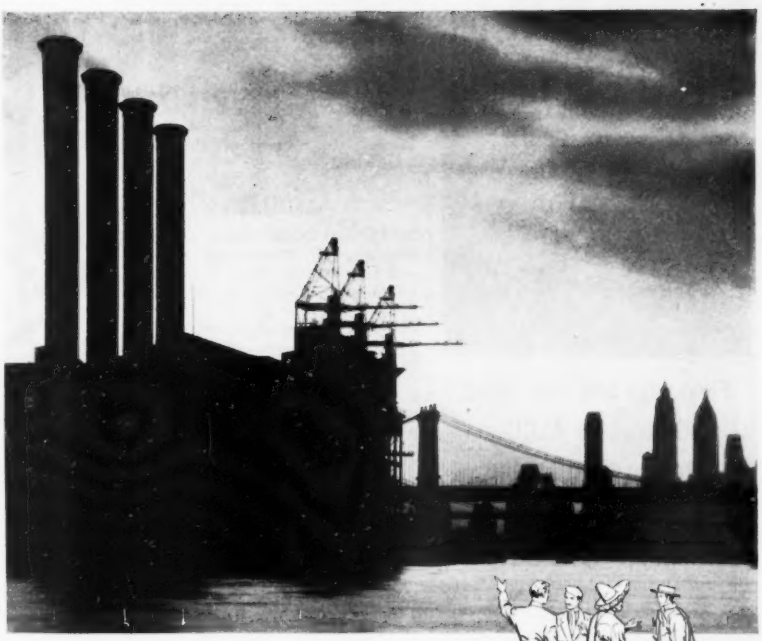
Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



What José tells Joe

WORD certainly gets around.

Kellogg's only fabricating shop for high pressure and high temperature piping is in Jersey City. Yet orders for power piping continue to come not only from the logical sales areas but also from Europe, Central America, South America and from half a dozen different geographical centers in the U. S. A.

Why? The answer we like to believe is that the word gets around that Kellogg installations leave no undesirable after-taste, that, to use a prosaic phrase, they leave only satisfied customers. And they should, because "built into" each installation are certain factors that virtually guarantee better than average performance and service life.

For example, there's extensive "creep-testing" of high temperature materials being conducted in Kellogg's metallurgical Laboratory. And there's the concurrent, continuous study of *graphitization*.

There's the exclusive apparatus for the *determination of stresses* in complicated piping installations. There are the *shop fabricating techniques* and *shop quality check system* that are considered among the best in industry.

There are the *field installation methods* that were nurtured on penstocks and matured on the field construction of more than half of the world's refinery cracking capacity.

And beyond these, there are *more than thirty years* of successful completion of the highest temperature and highest pressure power piping – including installations in some of the world's largest power plants.

These are the reasons why the word about M. W. Kellogg power piping gets around when José talks to Joe, or whenever and wherever in the world power men meet.

To master temperature, pressure and chemicals use

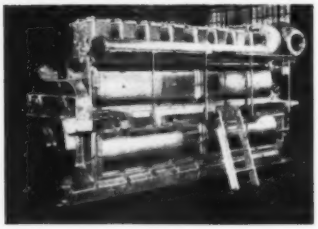
M. W. KELLOGG

process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) – Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

The ALCO PLAN for DIESEL ECONOMY



Flexibility and Low Cost Offered by ALCO Standardized Engine

THE ALCO plan helps Diesel plants where flexibility, economy, dependability, and provision for future growth are important. In one size of stationary Diesel engine, ALCO offers unusual advantages where multiples of 540 to 1,300 horsepower can be used.

LOW COST...This basic design, also used in ALCO switch engines, is quantity-produced to make both first cost and the cost of replacement parts unusually low.

FLEXIBILITY...You can fit fluctuating load curves more closely than with fewer engines of larger size, or of varied capacity.

LESS WEAR...This more efficient use of engines means less wear per installed horsepower. The unused capacity of operating engines at any time need not exceed the capacity of one engine. There is no wear on the idle engines. Larger engines would necessitate greater wear per installed horsepower, with resulting higher costs.

GREATER EFFICIENCY...With engines operating near rated load, fuel consumption is less and operating conditions are better.

UNIFORM ENGINE WEAR...With several units of the same size, engines can be operated in rotation, allowing planned inspection and maintenance with minimum "down time."

STAND-BY ECONOMY...When all units are the same size, stand-by capacity can be limited to one size of engine the same as all others. With a variety of engine sizes, stand-by capacity might easily have to equal the largest single unit.

SIMPLIFIED MAINTENANCE...Uniform engine size means uniformity of replacement parts and of maintenance procedures; smaller stocks of parts; minimum of special tools; shorter "down time."

EASY GROWTH...As demand increases, gradual growth can take place by adding extra units of the same size.

• • •

What your actual savings can be with this compact, efficient engine should be computed carefully. Call in an ALCO engineer to discuss the ALCO plan in relation to your needs.

AMERICAN LOCOMOTIVE COMPANY

Department D-6, 30 Church Street, New York 7, N. Y.

ALCO
STANDARDIZED
DIESEL ENGINES

sales, Norton Co, as second vice-president. C F Conner, manager, industrial products sales dept, B F Goodrich Co, has been elected treasurer.

George J Nicastro, sales engineer, Combustion Engrg—Superheater Inc, New York City, has been elected president of **New York State Society of Professional Engineers.**

OBITUARIES

Dr Arthur Berkeley Yates, 48, formerly chief geologist, International Nickel Co, died May 10 at the Royal Victoria Hospital, Montreal, Canada. He had been stationed for the firm at South Africa and had come to Montreal to receive the Barlow Memorial Medal of the Canadian Institute of Mining and Metallurgy.

C Neal Barney, 73, vice-president, secretary and general counsel of Worthington Pump & Machy Corp, died April 24 at his home in Scarsdale, N. Y.

S B Waring, 59, secretary-treasurer, Morse Chain Co, subsidiary of Borg Warner Corp, died May 11 at his home in Ithaca, N. Y.

Orville B Ewing, manager of New Orleans district office for Youngstown Sheet & Tube Co, died May 11.

Dana J Fox, 60, president and treasurer, Fretz-Moon Tube Co, Butler, Pa., died May 9.

Fred S Durham Sr, president, Bonney Forge & Tool Works, Allentown, Pa., died May 28.

Charles J Anderson, 56, chief engineer, Crouse-Irving Hospital, Syracuse, N. Y., died April 22.

FUEL PRICES

(*Continued from page* 166)

7. Scalf, F C, and associates, "Bituminous Coal Distribution, Calendar Year 1946," Mineral Market Report MMS No. 1592, U. S. Dept of Interior, Bureau of Mines, June 1948
8. Slifer, W L, Chief, Statistical and Research Section, Bituminous Coal Institute, personal communications, Washington, July 27, 1948, March 29, 1949
9. Young, W H, and associates, "Bituminous Coal and Lignite in 1946," Mineral Market Report MMS No. 1558, U. S. Dept of Interior, Bureau of Mines, Dec 22, 1947
10. Bituminous Coal Institute, "Bituminous Coal Facts and Figures," 1948 ed, Washington, Sept 1948

New York operation of Bergen Iron & Engrg Co has been incorporated under laws of State of New York and will be known as Bergen Genspring Corp, 15 Park Row, New York 7, N. Y., div of Bergen Iron & Engrg Co.

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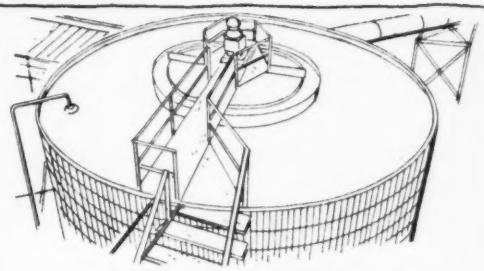
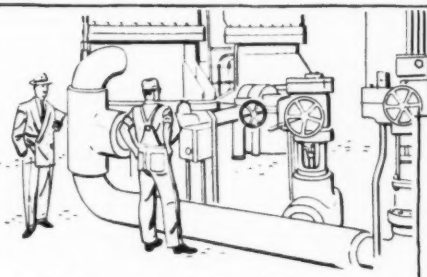
McGRAW-HILL PUBLICATIONS

YOU GET Complete Recommendations IN HALL BOILER WATER CONDITIONING

When Hall engineers have studied your plant, they recommend procedures which cover not only treatment of boiler water, but also all points of the water and steam cycle which affect the maintenance of desired conditions.

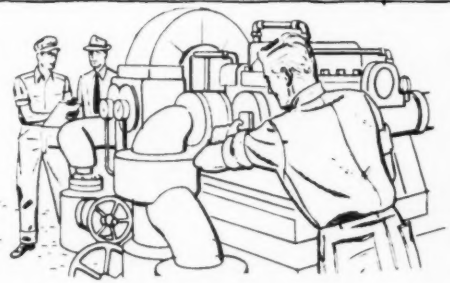


1. Where softening, clarifying or other pretreatment of raw water is advisable, Hall recommends types of equipment, advises as to results which can be expected with various types of equipment, and shows how to use new or existing equipment to best advantage.



2. Hall recommendations include procedures for the prevention of deposition in pre-boiler equipment, such as feed water heaters, valves, regulators, etc.

3. Water conditions which must be maintained within the boiler are prescribed; testing procedures for checking these conditions are set up; and detailed instructions for maintaining these conditions are given.



4. Steam-using equipment, condensing equipment and condensate return lines may present difficulties, and procedures for preventing these difficulties are part of Hall recommendations.

Hall Laboratories believes that its work can be summed up in a single phrase—*to do whatever is necessary to help you keep equipment operating effectively.* The best evidence of the value of Hall Service in accomplishing this is the hundreds of plants, large and small, who use Hall Service year after year. Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

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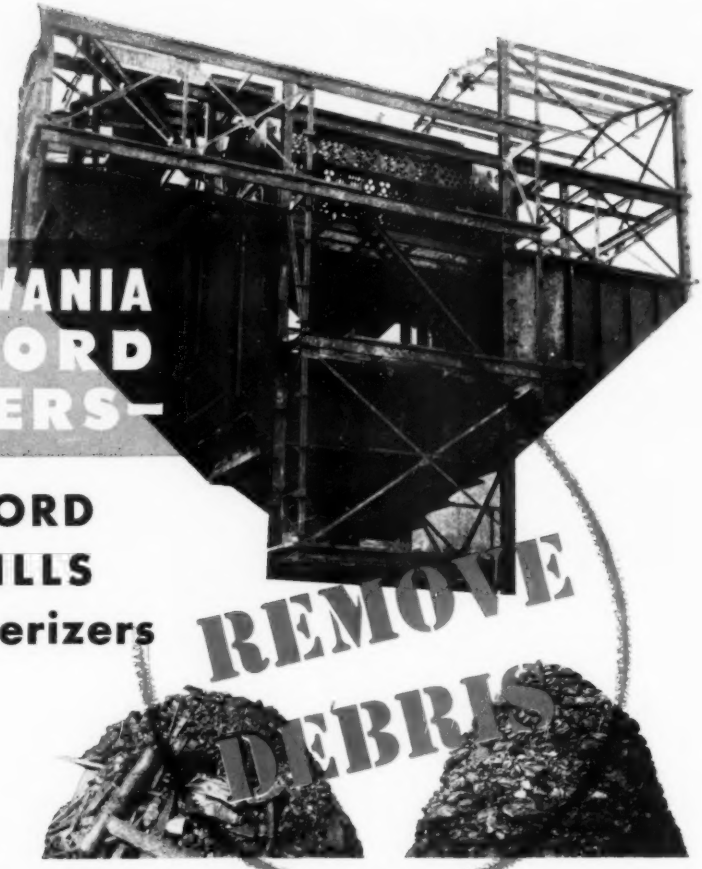
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

PENNSYLVANIA BRADFORD BREAKERS—

and BRADFORD HAMMERMILLS protect pulverizers



The "Pennsylvania" Bradfords are the only crushers that mechanically scavenge hard refuse. They automatically remove and discharge mine timbers, tramp iron, blasting wire, sulphur balls, slate, and rock which are larger than the Bradford screen perforations.

Recently data was compiled from 10 most complete installation records in six states, covering an average of 8.6 years of operation per Breaker. Over 35,000,000 tons of ROM coals were crushed and scavenged of refuse. *The average maintenance cost, including parts and labor, was under $.001 per ton—the average power consumption was .204 KW or .274 H.P. per ton.*

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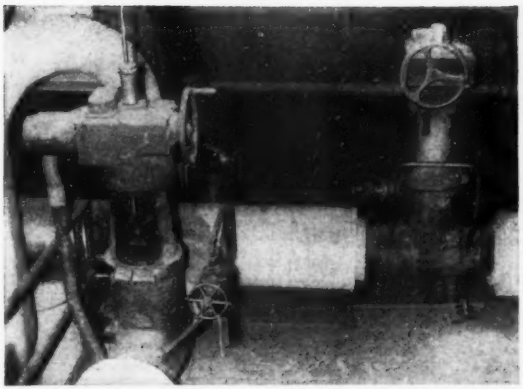
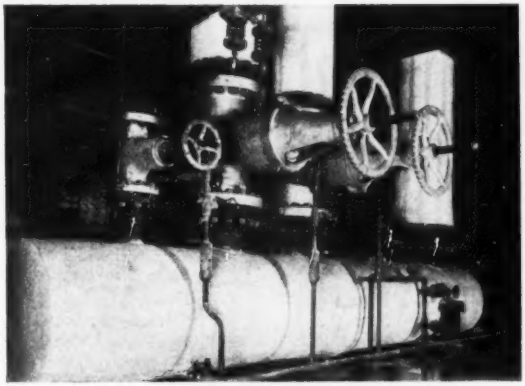
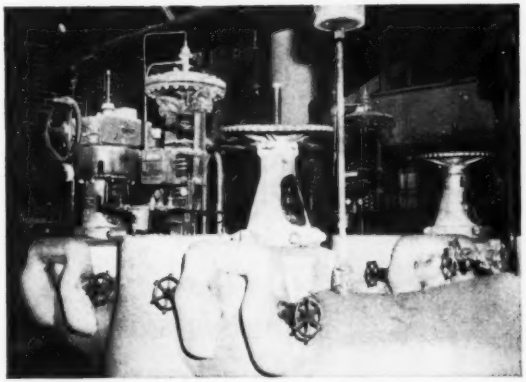


Walworth Motor Operated Series 900 Pressure-Seal Cast Steel Gate Valves.



Walworth Series 600 Pressure-Seal Cast Steel Gate Valves.



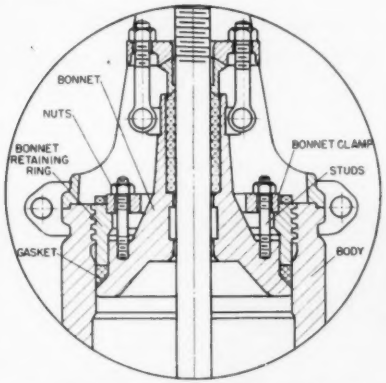
Manually operated and motor operated Walworth Series 900 Pressure-Seal Cast Steel Gate Valves.

WALWORTH PRESSURE-SEAL CAST STEEL VALVES

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved disc design provides flexibility, and helps keep seats tight, even when the valve body may be distorted by pipeline stresses, or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, and 1500 and in a wide range of sizes and types. For further information, see your nearest Walworth Distributor, or write: Walworth Company, 60 East 42nd Street, New York 17, N. Y.



A cross section of the bonnet joint assembly of a Walworth Pressure-Seal Cast Steel Gate Valve. The internal pressure is utilized to make the body-to-bonnet joint tight.

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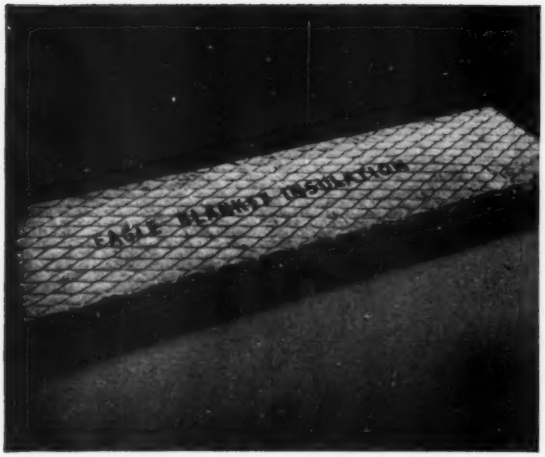

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Long service on heated equipment does not lower the high insulating efficiency of Eagle-Picher Blankets. Their principal ingredient, Eagle-Picher Mineral Wool, does not break down or deteriorate despite continuous exposure to temperatures as high as 1200 F. This physical and chemical stability enables Eagle-Picher Blankets to resist water, steam, moisture, corrosive fumes and normal vibration permanently. Complete technical and application data sent on request.

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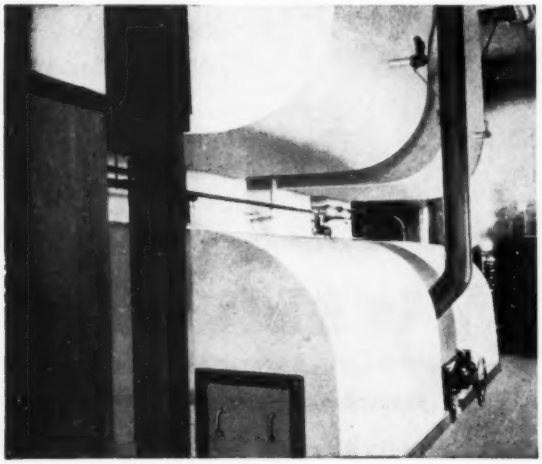

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What price liberty?

IT was Daniel Webster who said, "God grants liberty only to those who love it and are always ready to guard and defend it."

Today in our yearning for "security", we are inclined to forget about that "liberty" for which this old bell rang out. The two are not synonymous. When we permit a benevolent government to assume more and more responsibility for housing, feeding, hospitalizing, and even entertaining our citizens, we must in return expect to surrender more and more of our personal rights and liberties.

Actually, the only security any man can enjoy with liberty is the security he earns through his own initiative, resourcefulness and productivity. As community leaders, it is our responsibility to help our fellow citizens realize that for the delusion of government-guaranteed security they are sacrificing liberty.

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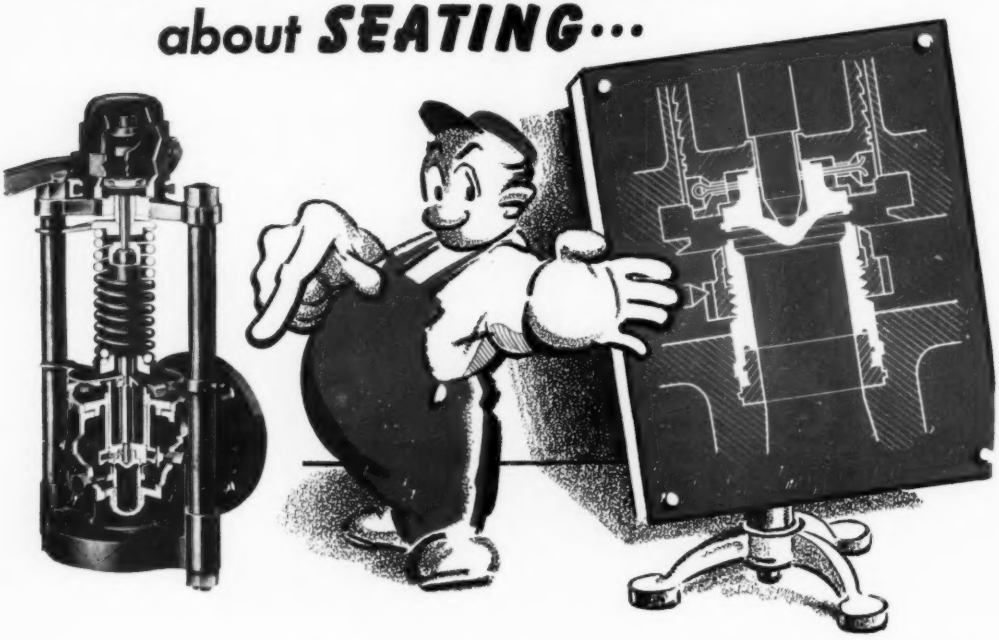
We Studied SAFETY VALVE LEAKAGE

— Here's what we found out about SEATING...



We found — what most power plant men already know...that in order to be tight, a safety valve must have matched, wear resistant, corrosion resistant seating surfaces, and that the disc must seat square.

We found — what power plant men have long suspected...that uneven expansion, causing dragging of one seating surface over the other, can destroy the seat so completely that the safety valve has to be overhauled or replaced, even though it has never been popped.

We found ...that when nozzle and disc are made of alloys with the same coefficient of expansion, and with sections designed so that their rate of heat absorption is the same, destructive drag is eliminated. This is one of the basic features of the Gentzel Design, and is the reason Foster 38-SV Safety Valves can be guaranteed to stay tight.

To you ...this means elimination of costly boiler outage due to safety valve leakage. Other guaranteed and proven advantages are...consistently accurate popping ...minimum blow-down, which can be held to as little as 1%...highest relief capacity for a given nominal valve size...and extremely low maintenance.

For full details on the design and construction features that enable this valve to outperform ANY other safety valve, get in touch with your Foster Representative or with us direct.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS... PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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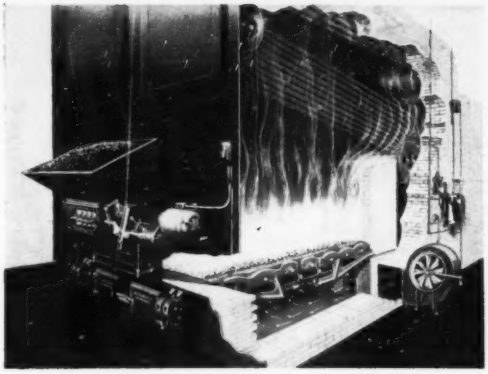
Product of a Modern Plant

THE STANDARD STOKER CO., INC.



WIDELY used in industry for more than 20 years, this popular spreader stoker is now manufactured in our modern plant at Erie, Pennsylvania. Standard Stoker's long experience in designing and building over 20,000 stokers for steam locomotives will be reflected in the quality and dependability of this industrial stoker. For boilers up to 1000 HP investigate the economy of operation and greater combustion efficiency of the Chicago Automatic Spreader Stoker. ***Write for descriptive literature — The Standard Stoker Company, Inc., Dept. B1, 370 Lexington Avenue, New York 17, New York.***

Consider these Spreader Stoker *Advantages*

1. Special grate construction permits ample shaking for ash disposal with minimum disturbance to the active fuel bed.
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3. A unique feeder and distributor combination assures the effective handling of wide ranges of coal sizes either wet or dry.
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PEERLESS VERTICAL TURBINE PUMPS

CUT OVERHEAD Underground

For your next job consider the flexibility and the efficiency of the Peerless vertical turbine pump.

As a deep well pump, for example, a Peerless pump can assure you of an independent source of clean water from your own well—water that will be of constant temperature, of constant chemical analysis. To cut overhead underground, Peerless turbine pumps embody many exclusive engineering advantages, such as patented Double Bearing-Double Seal bowl construction, all contributing to their extended trouble-free pumping life.

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Regardless of your requirements, a versatile Peerless vertical turbine pump will squarely meet your pumping demands. Peerless offers widest capacity range, from 15 to 30,000 gpm against heads to 1000 feet. You can have your choice of oil lubricated or water lubricated types and a choice of power drive, direct-connected electric, right angle gear, V or flat belt or combination drives. Write for individual Bulletins describing the applications of Peerless pumps to these services.

NEW PEERLESS INDIANAPOLIS PLANT IS DEVOTED ENTIRELY TO PUMP PRODUCTION AND SERVICE

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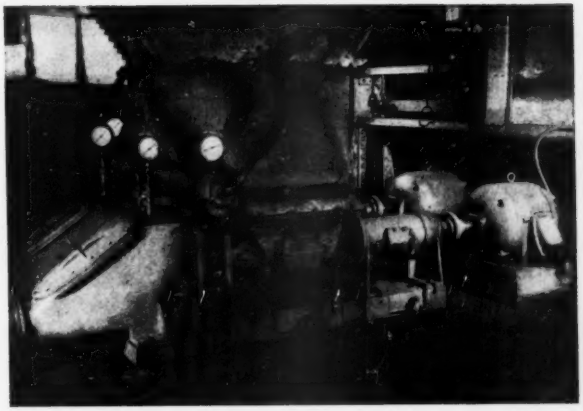
Peerless
VERTICAL AND HORIZONTAL
Pumps

FULLER KINYON

SYSTEMS *for* PULVERIZED FUELS



Two Fuller-Kinyon Stationary Pumps installed in the plant of Calumet and Hecla Consolidated Copper Company, Lake Linden, Michigan, for conveying pulverized coal.

TYPICAL MATERIALS CONVEYED BY FULLER-KINYON SYSTEMS

Asphalt filler dust
Barytes
Bauxite
Catalyst
Cement (Portland)
Cement raw materials
Chalk
Clay (dried)
Coal (pulverized)
Coke dust
Dolomite (pulverized)
Feldspar
Flue Dust
Fly ash
Fuller's earth
Gypsum (calcined)
Gypsum (raw)
Lime (quick)
Limestone (pulverized)
Magnesite
Manganese dioxide
Ores (pulverized)
Phosphate rock (pulverized)
Rock Dust
Soda ash
Starch

The Fuller-Kinyon Conveying System has been used for many years for conveying pulverized coal for the firing of rotary kilns and dryers in the cement industry, boilers in industrial plants, and large central power-generating stations. Also for metallurgical furnaces for gasification and by-product recovery; nodulizing, pelletizing and briquetting in metallurgical processes in which an ore is mixed with the fuel.

These systems have replaced many worn out or obsolete mechanical systems, with their fire and explosion hazards. The Fuller-Kinyon System is absolutely safe from such hazards, due to the fact that the quantity of air required for aeration of the material being conveyed is less than one percent of that necessary for combustion. The system is efficient, clean, and low in power consumption. The conveying pipe lines can be carried overhead, hung on simple hangers, or buried underground. Will convey horizontally, vertically, or uphill. Present systems convey materials as far as 3600 feet; elevations to 300 feet.

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P-105

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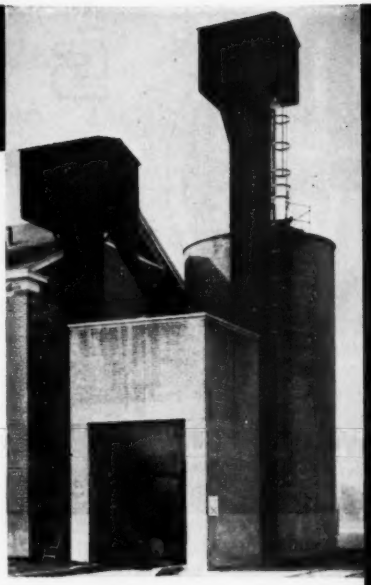

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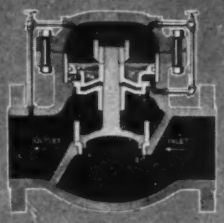
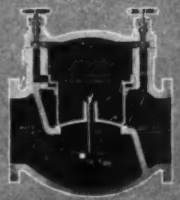
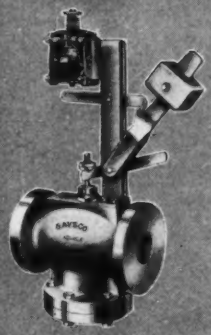
Everywhere



G-A Hydraulic Double Cushioned Check Valve, Globe Pattern.



G-A Double Cushioned Check Valve, Globe Pattern.



G-A Electric Trip Double Cushioned Check Valve, Globe Pattern.

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GOLDEN-ANDERSON
positive control
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You will find Golden-Anderson "Positive Control" Check Valves *providing economical protection for valuable equipment* in America's largest Power Plants. Balanced Check Valves prevent reversing of pump and motor by closing instantly before reverse flow occurs. Double Cushioning feature eliminates serious surge and "water hammer" on emergency shut-down of pumps.

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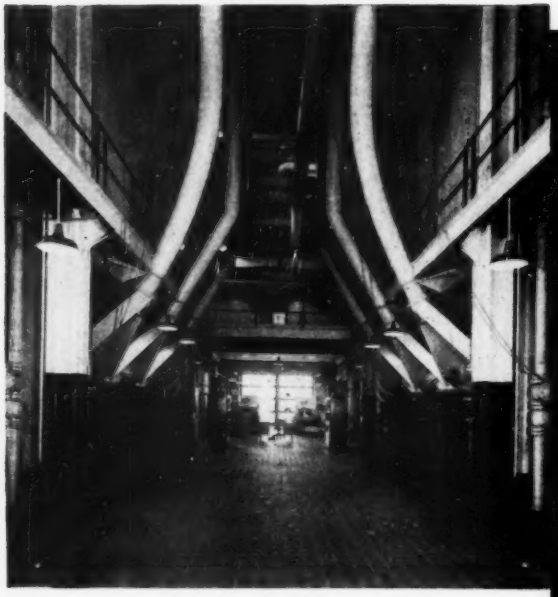
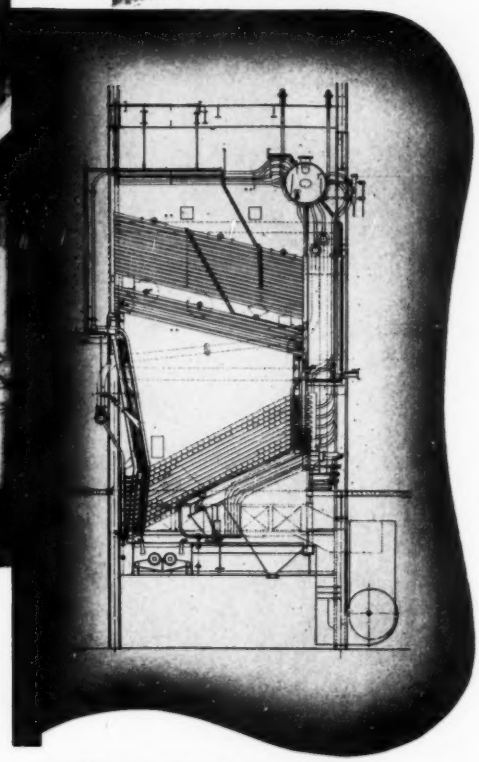
More Heat for the NATION'S CAPITAL





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STEAM GENERATORS

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Principal Data, Each Unit

220,000 pounds steam per hour capacity
Steam and water drum is fusion welded and designed for 400 pounds S.W.P.
Sinuous forged steel tube headers. Water cooled furnace walls.

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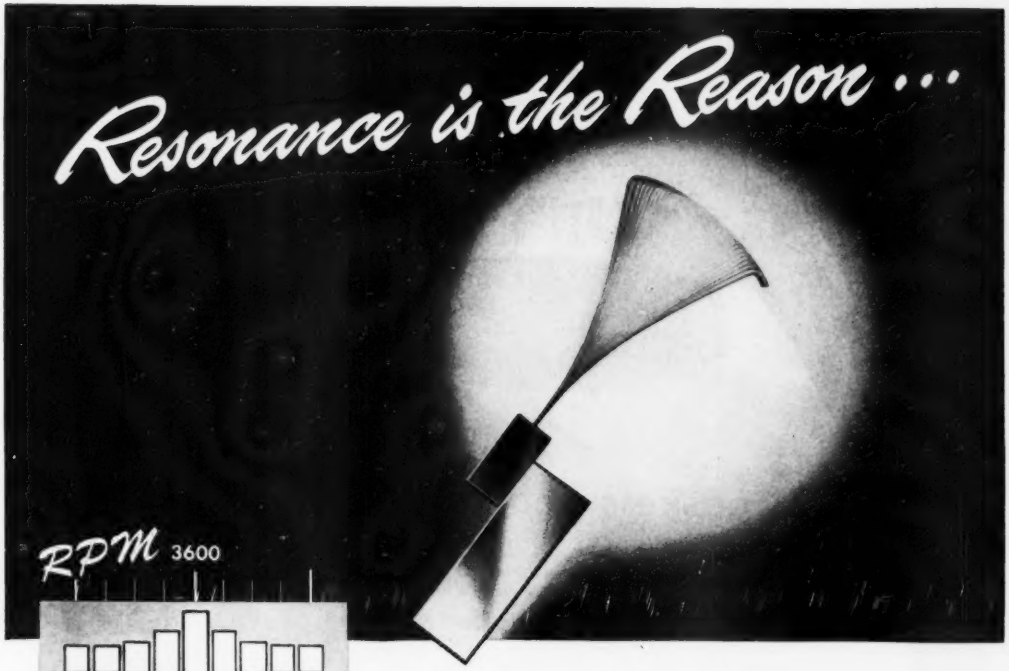
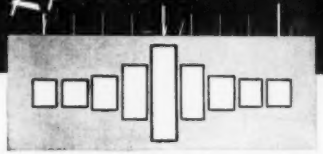
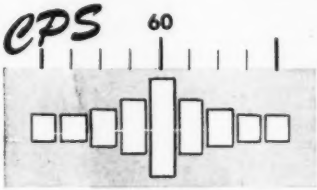
Resonance is the Reason . . .

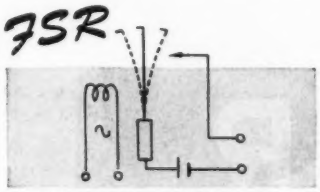




TACHOMETER (Revolutions per min.)



FREQUENCY METER (Cycles per sec.)



FREQUENCY SENSITIVE RELAY

The natural phenomenon of resonance in a steel reed provides the operating principle for a unique series of instruments that measure speed, frequency and rate of vibration.

Of the utmost simplicity, Frahm Resonant Reed Tachometers and Frequency Meters contain a set of steel reeds—with each reed tuned to a definite period of vibration. When minute vibratory impulses enter the reeds through the frame on which they are mounted, individual reeds come into resonance and clearly indicate the frequency of vibration in cps or rpm. It's as simple as that!

Frahm Tachometers can be mounted directly on turbines and other equipment—and require no electrical, gear or belt connections. Portable types are also available . . . operate merely by contact. Various speed ranges can be covered from as low as 900 to as high as 100,000 rpm or vpm.

Frahm Frequency Meters, portable or permanent, indicate alternating current frequency from as low as 15 to as high as 1500 cps. A small electro-magnet actuates the reeds.

Frahm Frequency-Sensitive Relays operate either *on* a given frequency impulse or upon slight deviation *from* a specific frequency. They are particularly appropriate where a frequency impulse can be superimposed, such as on a d-c circuit.

We will gladly send you full details on any or all of these Frahm Resonant Reed Instruments and their applications. The following bulletins are available:

Frahm Tachometers—Bulletin 31-P.
Frahm Frequency Meters—Bulletin 32-P.
Frahm Sensitive Relays—Information on Request.

JAMES G. BIDDLE CO.
Electrical & Scientific Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA.

R/M Nos. 700, 715, and 718

R/M gaskets and gasket tape

Raybestos-Manhattan manufactures a variety of gaskets and gasketing tapes for handholes, manholes, steam chests, heater heads, boiler tube caps, furnace doors, and other uses.

R/M Asbestos Metallic Gaskets, Style No. 700, are furnished in a variety of shapes and sizes. They are made of asbestos cloth, reinforced with tightly woven brass wire and treated for resistance to high temperatures.

R/M Folded Gasket Tape, Style No. 715, is of the same material as R/M Style No. 700, and is available in more flexible form (Style No. 718) without the woven wire insert. These two tapes resist the action of steam, air, gas, water, ammonia, acids, and alkalis. They give exceptional service on rough or uneven flanges and wherever there is considerable expansion and contraction.

R/M Tube Cap Gaskets—Seamless—Style No. 730, are accurately formed to fit standard B & W, Heine, and Edgemoor boiler tube caps. They are of seamless and endless woven asbestos tubing, reinforced with woven wire and treated to resist high temperatures.

For full information on these and other R/M gaskets and gasketing tapes, or for full information on R/M packings for all types of industrial machinery, see the authorized R/M packing distributor near you.

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

Factories:
Bridgeport, Conn.; Manheim, Pa.;
No. Charleston, S.C.; Passaic, N.J.

RM

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts Radiator Hose • Powdered Metal Products • Bowling Balls

All These Were Once
DUST COLLECTION PROBLEMS, TOO

48 Carbon Black Plants

203 Metallurgical Installations

205 Acid Plants

40 Paper Mills

270 Detarring Installations

216 Power Stations

73 Steel Plants

99 Oil Refineries and Miscellaneous Installations

Your electrical precipitator installation will be individually engineered...and based on the Research Corporation's *experience* graphically shown by that towering pile of thousands of blue prints.

This knowledge is a valuable asset that will help Research engineers to "tailor-make" your Cottrell installation. For example, they can more quickly determine the right answers to such variables as the size, shape and type of both discharge and collecting electrodes, their relative spacing, flue arrangements and many other factors. At Research you can count on *profitable solutions to individual problems.*

In hundreds of power plants today, Research Corporation Cottrells are collecting 90% to over 99% of fly ash from pulverized fuel boilers. Write for your free copy of an informative booklet giving valuable data on these installations.

RC-116

Typical One Day Collections:

250 TONS OF FLY ASH • 6 TONS OF SODA SALTS AT A PAPER MILL • 25 TONS OF SODIUM SULPHATE AT A KRAFT MILL • 6 TONS OF BLAST FURNACE DUST

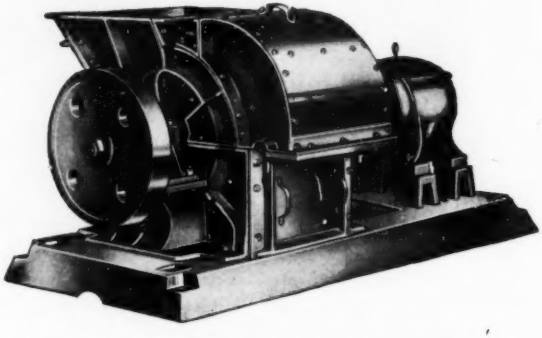
RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois

ASSURE MORE EFFICIENT *FIRING* THROUGH MORE EFFICIENT *PREPARATION* with AMERICAN CRUSHERS

Shown above is the preparation plant of the Windsor Power House Co., Power, W. Va., where the American Rolling Ring Crusher Model 42S (in insert) is in daily operation.

Quality of coal crushing is as important to combustion efficiency as the quality of coal itself—one reason why Americans are chosen by so many power plants to do the crushing job. The *splitting action* of Americans assures uniform sizing—no oversize—and fines are accurately controlled. The result: a dependable, constant yield of stoker or pulverizer size to assure a uniform, responsive firebed—for greater operating efficiency.



Designed especially for power plants, the American "S" Crusher is a compact, complete crushing operation which is installed in minimum headroom without extensive conversion—and with no auxiliary crushing facilities. Nine different sizes, with capacities from 25 to 500 TPH.

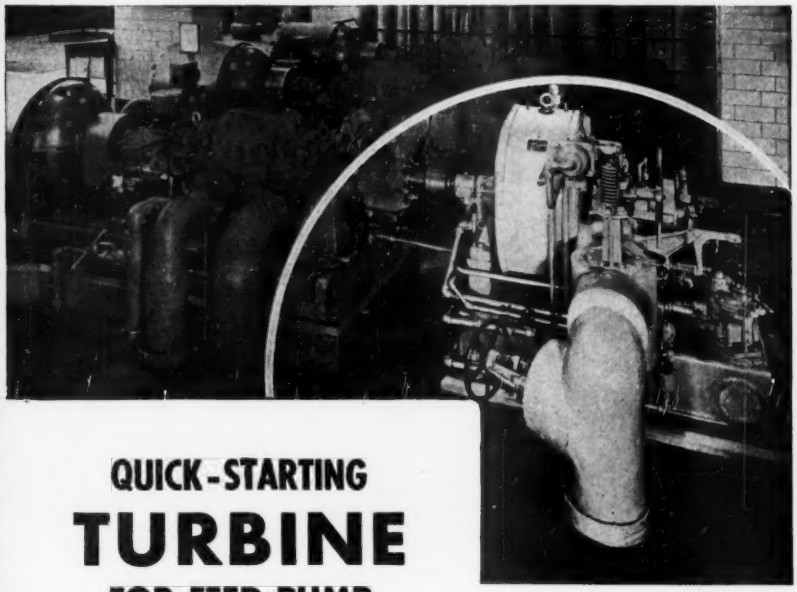
Write for bulletin on efficient coal preparation in power plants.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

TERRY



QUICK-STARTING
TURBINE
FOR FEED PUMP
EMERGENCY DRIVE

The turbine shown at the right picks up the feed-pump load in case the motor, which normally drives the unit, is inoperative. Thus the turbine must be able to start quickly and be completely reliable —characteristics which are assured by the generous blade clearances and one-piece construction of the Terry Wheel.

This is but one example of many special turbine requirements that are met by the Terry solid-wheel turbine. Details on how this and other Terry Turbines will meet your individual needs will be gladly supplied by a Terry engineer.

DATA

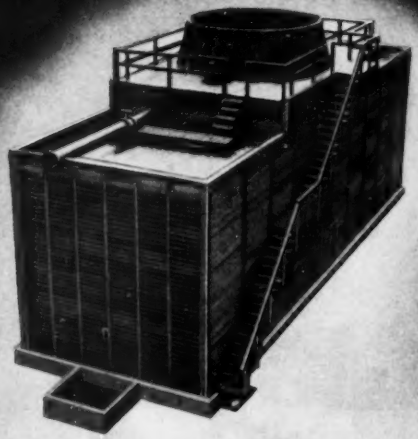
The turbine is 620 hp, 3550 rpm for 850 psi, 900F steam with 2.5 psi back pressure.

Installed in the Crawford station, Middletown, Pa., Metropolitan Edison Co. Gilbert Associates, Inc. were the consulting engineers.

T-1178

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Specify MARLEY Double-Flow



FOR SAFE OPERATION AND MAINTENANCE

STAIRWAY . . . DOUBLE-FLOW towers are equipped with a stairway built at the enclosed endwall of the tower. This eliminates fog envelopment and ice formation on stairways or ladders built over louvered sections. Operators do not have to climb high, dangerous ladders.

HANDRAILS . . . stairway and wide, level fan deck are guarded with high handrails. At no time is the operator at the mercy of high, gusty winds or in danger of inadvertently falling off the tower.

OUTSIDE WALKWAY . . . a short stairway leads to a walkway over each distribution basin. Water level may easily be adjusted or the basin cleaned. Complete flexibility of operation or maintenance is a result without the usual risks and dangers involved.

INSIDE WALKWAYS . . . through the interior of the tower, walkways enable the operator to observe water breakup, condition of structure, and operating conditions of the tower. This can all be checked while the tower is in operation without danger to the operator.

WALLED FAN CYLINDERS . . . each fan is enclosed with a fan cylinder . . . high enough for safety, low enough for easy inspection. And, there is plenty of room between the cylinder and fan deck railing for free movement without risk.

Tower owners and operators know that MARLEY DOUBLE-FLOW towers are SAFE TOWERS . . . safe in any stage of operation or maintenance . . . safe in any weather.

That's why more and more Safety Engineers of America's great industries are recommending MARLEY DOUBLE-FLOW COOLING TOWERS.

Ask for a MARLEY Factory-Trained APPLICATION ENGINEER to tell you more about the MARLEY DOUBLE FLOW Cooling Tower and its numerous SAFETY FEATURES. He'll be glad to help you solve YOUR water cooling problems. No cost or obligation.

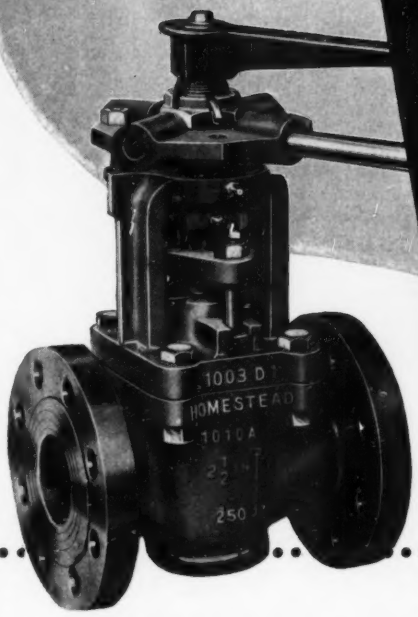
MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

~~Corrosion~~...~~Temperature~~...~~Pressure~~ Can't faze

HOMESTEAD Lever-Seald VALVES

They're Stick Proof



- Instant Stick-Proof operation.
- Quarter-turn fully opens or closes.
- Positive seal without lubrication.
- Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated.
- Unobstructed straight-line fluid flow.
- All operating parts protected from damaging effects of service conditions and weather.

For 16 years, they have been first choice for difficult services where extremes of temperature or pressure or corrosive line fluids cause ordinary valves to "stick" or "seize." Due to their exclusive "Lever-Seald" construction, they render instant, Stick-Proof service. They operate fast, too . . . full open or close in a quarter-turn . . . 16 to 28 times faster than screw-stem-type valves. And because all operating parts are protected from the damaging effects of line fluids, service conditions and weather, long life, low maintenance and trouble-free service are assured.

HOMESTEAD LEVER-SEALD VALVES are made in metals and alloys to meet service requirements; sizes 1½" to 12"; for pressures from vacuum to 1500 pounds.

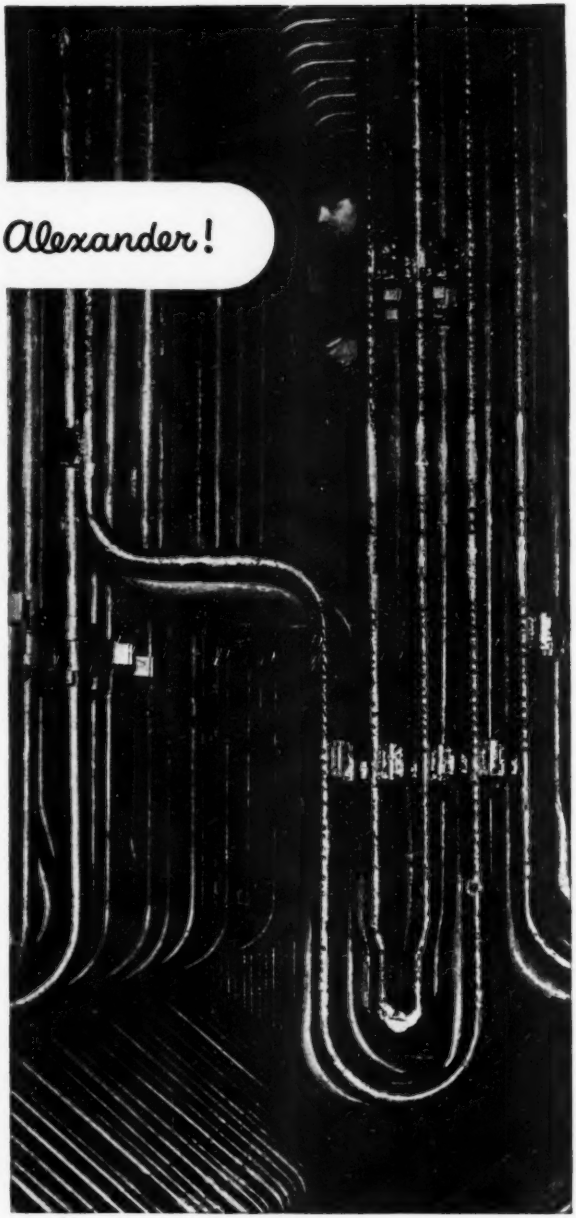
Send for your copy of Reference Book No. 39-3. No obligation.

HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1892"

P.O. BOX 210 **CORAOPOLIS, PENNA.**

Take a gander at Mr. Alexander!



HERE's a candid camera shot of the gentleman making a grand tour of the reheater elements of one of the highest pressure, large utility boilers in the country.

If you look closely you'll see that Mr. A. appears rather pleased. And, why not? That stack of tubes he's giving a final once-over is all set for a long term of trouble-free performance because they're all NATIONAL Seamless —none better for handling extreme temperatures, high pressures or complicated assemblies like this.

Do you know why so many public utilities have standardized on NATIONAL Seamless Boiler Tubes—why you'll find them preferred in high pressure steam plants of all kinds — why NATIONAL Seamless stands for safety, security, and dependability wherever used?

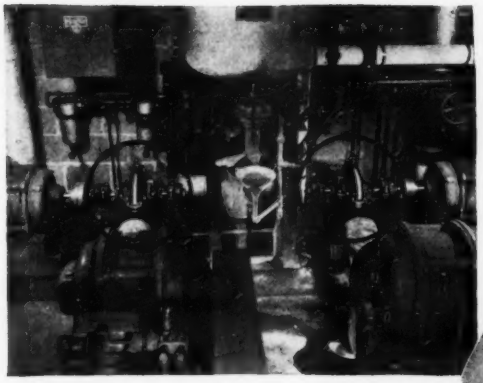
It's because NATIONAL Seamless Tubes are *pierced from solid billets of steel* . . . are made by the only process that absolutely removes all uncertainty regarding uniform wall strength.

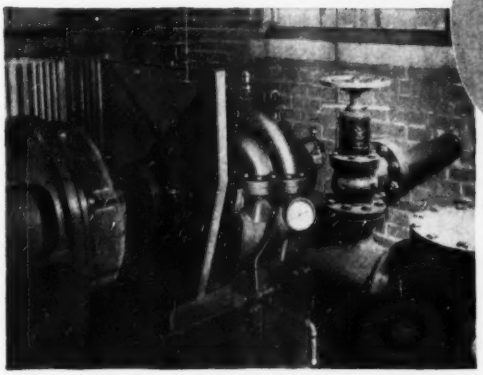
What is equally important, these superior tubes—these original "Walls Without Welds" —that power plant engineers have confidently put their trust in for the past sixty years, have been continually improved. Constant advancement in tubular metallurgy and fabrication assures dependability and economical operation under today's increasingly heavier loads—and incidentally, makes them the easiest tubes to work with.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.
(TUBING SPECIALTIES DIVISION)
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

NATIONAL (WALLS WITHOUT WELDS) *Seamless*
BOILER TUBES
UNITED STATES STEEL





No Better Pumping Economy than TROUBLE-FREE SERVICE

YOU'RE SURE OF IT WITH "BUFFALO" SL PUMPS

Pump breakdowns and the delays they cause are costly! On the other hand, the cost of a good pump well installed is absorbed by years and years of service WITHOUT repairs and delays.

"Buffalo" SL Pumps for clear water are giving just this kind of economy in boiler feed, air conditioning and other installations. These efficient double suction pumps are HEAVILY BUILT in every part to stand up under severe service. Couplings, shafts and bearings are strong enough for the heaviest loads. The heavy casing is horizontally divided for easy pump inspection. All parts are carefully machined for accurate fit and smooth performance, and these pumps are always in perfect hydraulic balance under all conditions of head and pressure.

Pick the capacity you want—10 to 10,000 G.P.M. You can't buy better or lower-cost clear water pumping service than with "Buffalo" SL Pumps!

FREE ON REQUEST!
New Bulletin 955-N right, gives you the engineering reasons WHY "Buffalo" Double-Suction Pumps mean LIFETIME pumping economy. Write for your copy!

"Buffalo" PUMPS

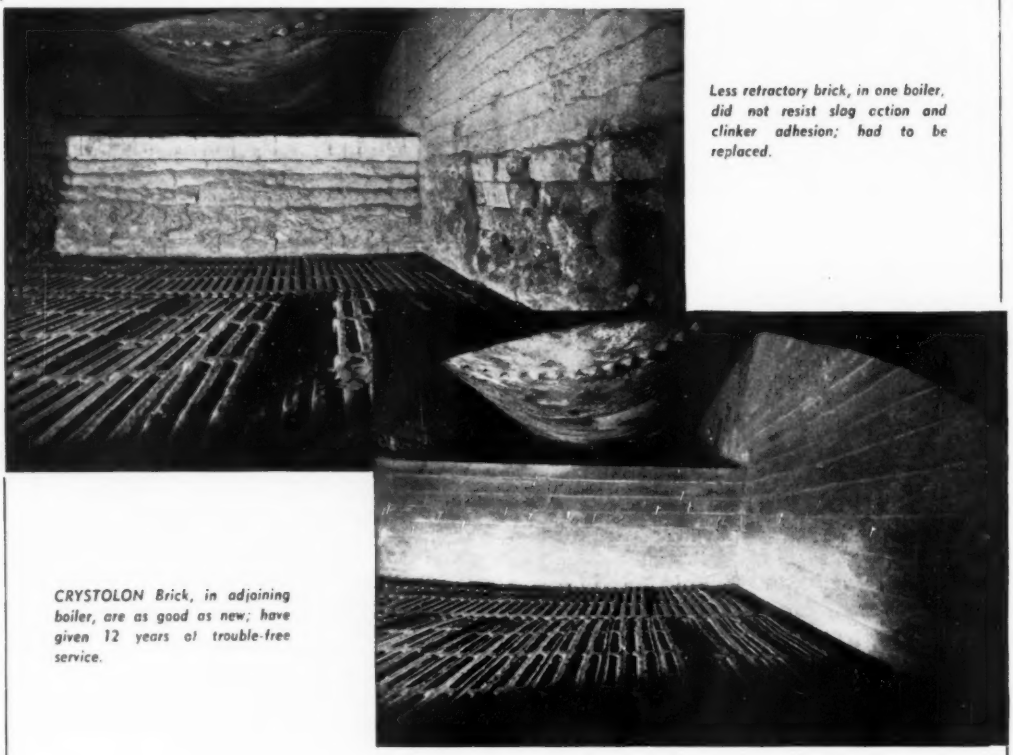
BUFFALO PUMPS INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Comparisons prove that for economical service the *qualities* of CRYSTOLON* Brick are *important*



Less refractory brick, in one boiler, did not resist slag action and clinker adhesion; had to be replaced.

CRYSTOLON Brick, in adjoining boiler, are as good as new; have given 12 years of trouble-free service.

Densely made of silicon carbide, CRYSTOLON Brick offer four outstanding features: (1) resistance to slag action, (2) resistance to clinker adhesion, (3) resistance to high temperatures, (4) resistance to abrasion. Whether in handfired jobs illustrated above where heat is important or in stoker installations where power may be the objective, CRYSTOLON Brick give long, trouble-free service. They demonstrate their reliability best where conditions are most severe.

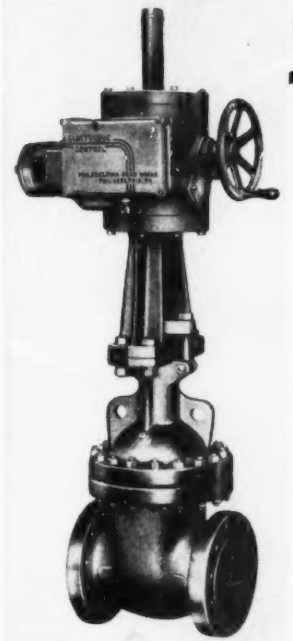
NORTON®

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

*Trade-mark Reg. U.S. Pat. Off.

POSITIVE, SAFE AND AUTOMATIC

Push-Button CONTROL OF VALVES BY Limitorque



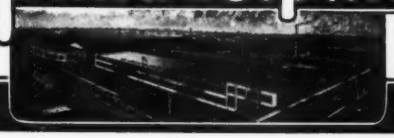
By the push on a button, the opening and closing operations of valves of all types are speeded up, while labor costs are simultaneously reduced. Doors, damper controls, sprinkler systems, feeder disconnect switches, marine ventilating covers, watertight bulkhead doors, as well as Gate, Globe, Butterfly, Plug valves and sluice gates can be easily and automatically operated.

LimiTorque Control gives absolute assurance against improper seating, by means of a positive safety overload mechanical torque cut-out. . . . If obstruction is met in closing valve, torque switch becomes operative and disconnects the motive power—thus preventing broken gates or discs and damaged stems.

Various types of **LimiTorque** Controls are available for different valve requirements on all types and makes of valves—also, they can be adapted to existing equipment. And, where it is not practical to fit the controls directly to the valve yokes, floor stands can be provided.

NOTE: Send for 96 page "Limitorque" Catalog—and please use your Business Letterhead when requesting same

Philadelphia Gear Works, INC.



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NEW YORK • PITTSBURGH • CHICAGO
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street — Pittsburgh, Penna.

Woolworth Building, New York
Chamber of Commerce Bldg., Indianapolis
Book Tower, Detroit
525 Market Street, San Francisco
Whitehead Building, Atlanta
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

When you modernize an existing piping system or install a completely new one—shop fabrication and field erection by Pittsburgh Piping and Equipment Company can relieve you of many responsibilities and assure an installation that is superior in reliability and economy of operation.

P. P. & E. shop fabrication is an advanced technique developed over a period of almost fifty years of specialization in high pressure, high temperature piping. It begins with the blueprint and ends only when the system is in operation.

The prefabricated sub-assembly shown—for a hydraulic piping system operating at a pressure of 2500 p.s.i.—is typical of the complex designs that are feasible in our shops, and which facilitate accurate, economical erection.

When you modernize your plant, entrust responsibility for the complete piping system to an expert. Consult our nearest representative.

HERE'S WHAT YOU CAN HAVE *in your* BOILER ROOM · · ·

1. More steam from your present boiler.
2. Less fuel — coal — oil — gas — required.
3. Savings in maintenance whether you have a single boiler or battery of boilers.

HERE'S WHAT DOES THAT JOB FOR YOU · · ·

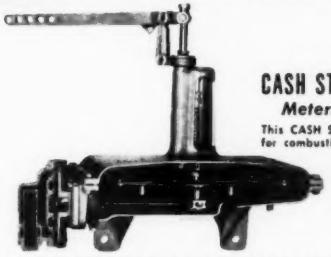
CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

HERE'S HOW IT IS DONE!

CASH STANDARD FUEL FEED CONTROLLER · · ·

Automatically Regulates Fuel Feed

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion —hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER · · ·

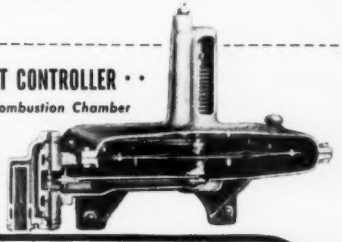
Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

CASH STANDARD FURNACE DRAFT CONTROLLER · ·

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

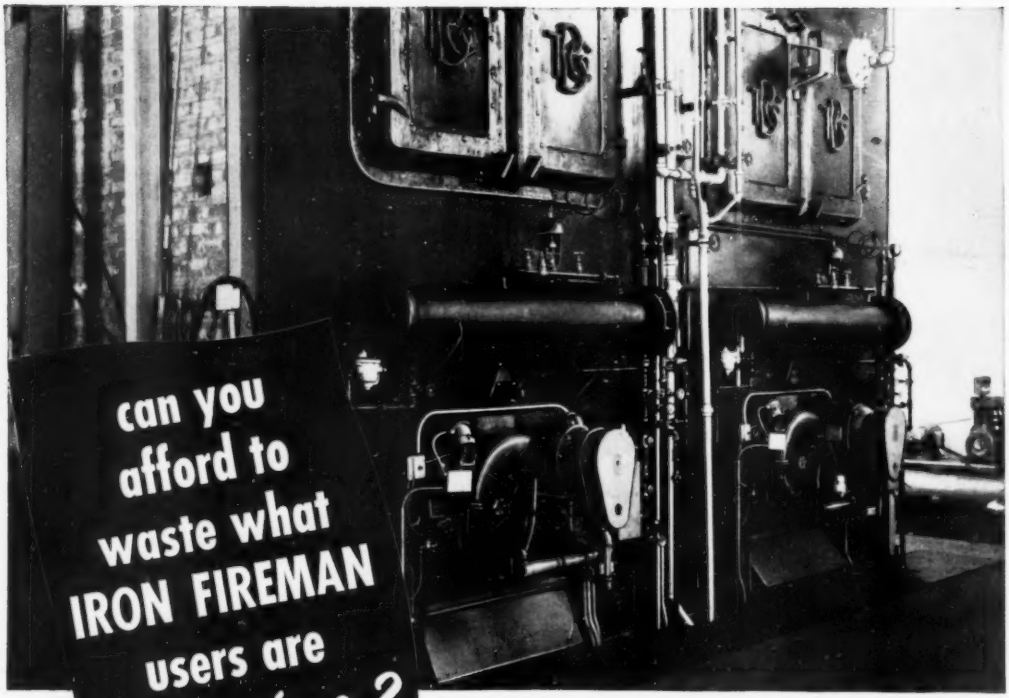


Bulletin No. 300
SHOWS APPLICATIONS
...TELLS HOW THE SYSTEM WORKS IN YOUR FAVOR
Send for it

Tells about Correct fuel feed — Correct fuel-air ratio — Correct over-fire draft and how you get all three. It shows applications and how various CASH STANDARD Units can be made to meet any specific condition and work on any boiler or stoker with any kind of fuel.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES



Iron Fireman Industrial oil burners firing two 150 h.p. Bigelow H.R.T. boilers in boiler room of Flowerwood, Inc., Crystal Lake, Illinois. Steady steam pressure is constantly maintained regardless of load demands from 4 large greenhouses. (When completed, the range will consist of 8 greenhouses.)

Flowerwood, Inc. uses Iron Fireman oil burners

to save fuel and labor costs in automatic heating of 4 huge greenhouses

Flowerwood, Inc. of Crystal Lake, Illinois, growers of gardenias and camellias, uses Iron Fireman oil burners for two main reasons:

1. Save Fuel Costs. "This plant indicates a considerable saving over the firing method we previously used," states Robert J. Sordet, Manager. The Iron Fireman oil burners have "very successfully burned bunker 'C' oil. Actually, in one instance, a load of lighter oil was delivered by error, and there were absolutely no oil or air adjustments needed."

2. Save Labor Costs. "The heating plant itself actually operates without any attendance whatsoever, except for normal hourly checks of water level, and general observation."

Heavy economical oils controlled automatically by Iron Fireman Oil Volumeter

Iron Fireman's exclusive Oil Volumeter controls fuel-feed rate, regardless of oil temperature or viscosity. It is a positive displacement, variable-volume pump submerged in the oil reservoir. Multiple pistons meter the exact amount of fuel required. It gives a smooth, even fuel feed—a steady flame all the time. No ports to adjust. No viscosity compensating devices.

What about YOUR boiler plant? Can you afford to waste what Iron Fireman users are saving? An Iron Fireman technical man will be glad to make a survey of your present steam plant operation, without cost or obligation to you. You can thus determine in advance approximately how much an Iron Fireman installation will save for you, and what other benefits it will bring.

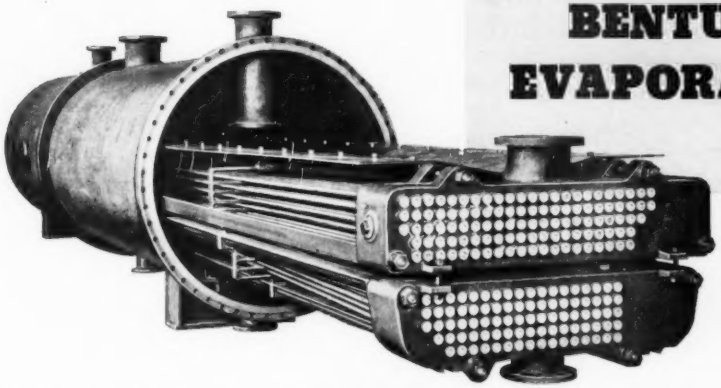
Write for free literature. Iron Fireman Manufacturing Co., 3122 West 106th Street, Cleveland, Ohio. Other plants in Portland, Ore.; Toronto, Ontario. Dealers everywhere.

IRON FIREMAN

Commercial and Industrial Firing Equipment for GAS, OIL and COAL

PUREST Make-Up Water

from the ..... **G-R BENTUBE EVAPORATOR**



NO MATTER what the kind or amount of impurities in your feedwater supply, you can count on getting pure distilled boiler feed make-up from a G-R Bentube Evaporator. This make-up water is, in fact, *purer than that obtainable by any other method.* Its hardness is as low as one part per million. Silica content can be reduced to one-tenth part per million.

You can be sure, too, that a G-R Bentube Evaporator will maintain rated capacity throughout its long life. That's because of the patented design of the G-R Bentube elements, which are set with a slight initial curvature into the cast headers. *This exclusive scale-shedding design completely eliminates hand scaling.* Variations in temperature cause changes in the curvature of the tubes, thereby shedding the scale from the tube surface at regular cracking periods and during normal operation.

In addition, the G-R Bentube Evaporator offers distinctive features that assure 100% effective evaporating surface, pure dry vapor, minimum pressure drop of steam through the evaporator, free dropping of scale to the bottom of the shell and convenient access to the shell interior.

BULLETIN 366 *fully describes the wide-range line of* G-R BENTUBE EVAPORATORS. *Write for your copy today.*

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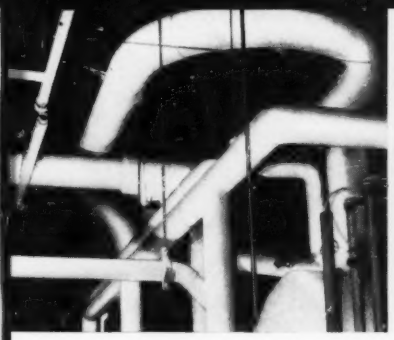

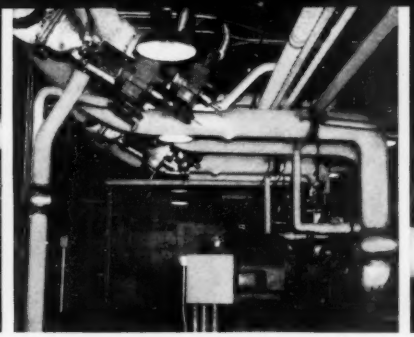

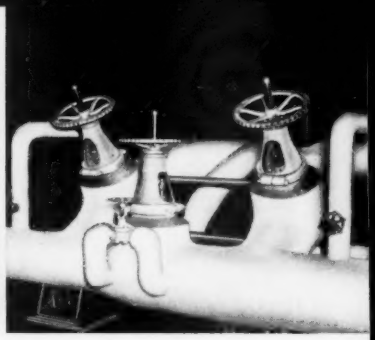

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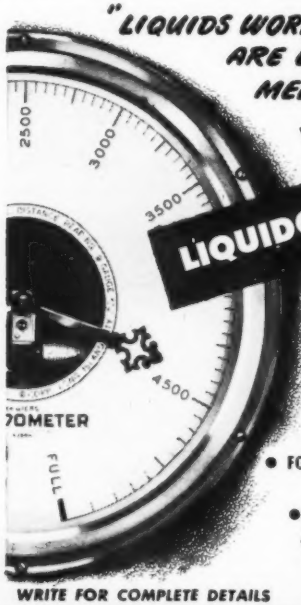

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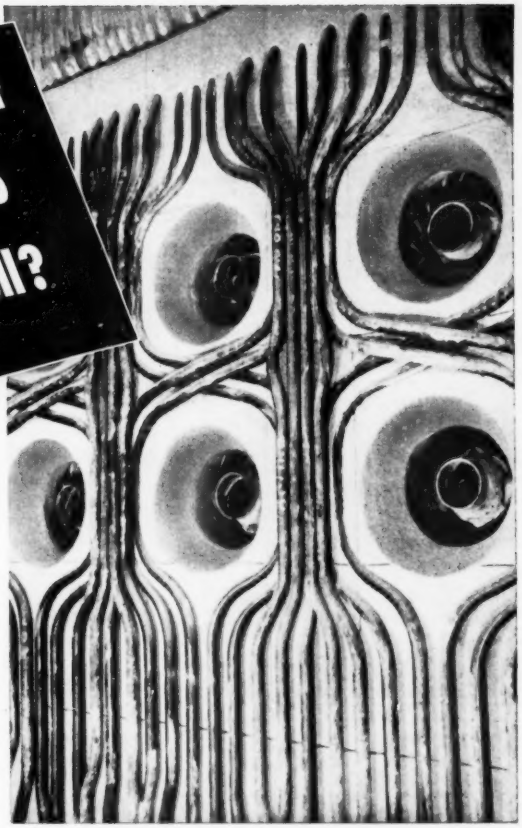

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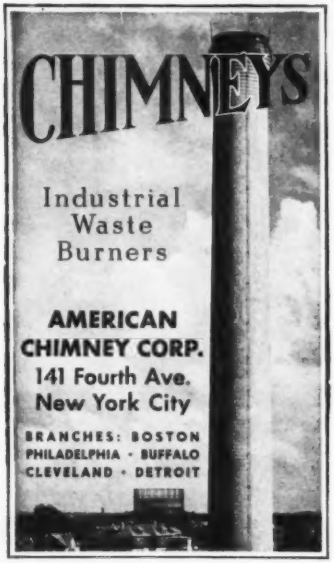

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75	Cr. W. New b.b.	CMC	230	1150
75	Allis Ch.	E	230	500
75	Whse.	S13L	115	870
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100	Gen. Elec.	C	250	750
75	Allis Ch.	E	250	750
75	Whse.	S	125	600
75	Cr. Wheeler b.b.	CCD	250	1450
75	Gen. Elec. (2)	RC36	125	1200
50	Gen. Elec.	RC36	250	850
50	Gen. Elec.	RC	250	1250
40	Gen. Elec.	RC32	250	1450
30	Elec. Prod.	BP	50	1150
30	Gen. Elec.	RC	250	1500
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150	Gen. Elec.	IK-16	440	750
80	Allis Ch.	ANY	440	750
50	G.E. int.	MTC5337	440	750
50	G.E.	I-K	440	750
50	Gen. Elec.	KT339	440	1500
40	Gen. Elec.	KT343	440	750
20	Gen. Elec.	KT327	440	750
15	Whse. TEFC	CS305	220/440	1500
15	Reliance TEFC	C444	220/440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
375	Whse.	G	240/480	900
300	Gen. Elec.	ATB	240/480	720
250	Whse.	G	2300	600
200	Gen. Elec.	ATB	240/480	600
187	Gen. Elec.	ATB	240/480	900
156	G.E. 1 brg.	ATB7558	240/480	1200
150	Gen. Elec.	ATB	2300	450
150	Gen. Elec.	ATB	240/480	900
125	Gen. Elec.	ATB	240/480	300
100	Whse.	G	2300	900
100	Gen. Elec.	ATB	240/480	1200
75	Gen. Elec. New b.b.	ATI7552	240/480	1200
56	Gen. Elec.	ATB	240/480	1200
56	Gen. Elec.	ATB	240/480	900
25	L. Allis	ALT	240/480	1200
25	Whse. b.b.	1 ph.	120/240	900
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	Allis Ch.	ANY	450
2—	300	Allis Ch. 2200 V.	ANY	720
1—	300	G.E. 2200 V.	I-M	1800
1—	300	Whse. 2200 V.	CW	600
1—	250	G. E. 2300V.	MT	300
1—	200	Cr. Wheeler	SR	600
1—	200	Gen. Elec.	IM-17A	450
1—	150	Whse.	MW	450
1—	150	G.E. 2200/4000 V.	I-M	1200
1—	150	Allis Ch.	ANY	600
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
1—	100	Allis Ch.	ANY	720
1—	100	Whse. int. 2200 V.	C1856C	600
1—	100	Whse. int.	CI-756A	720
1—	100	Fair, Morse b.b.	HV	900
1—	75	Fair, Morse b.b.	HV	1200
2—	75	Gen. Elec.	IM-14	720
1—	75	G.E. int. duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT358	600
2—	75	Gen. Elec.	IN-14	600
1—	75	Gen. Elec.	MT337	1800
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec.	MT336	900
1—	37	G.E. int.	ITC	600
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
2—	25	Gen. Elec.	MT332	900
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	Gen. Elec.	MT326	900
1—	15	P & H b.b. int.	W7	1200
14—	10	Reliance New b.b.	AW-324	1800

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
450	Whse.		220/440	900
300	Whse.	G	2200/440	600
250	Ideal	2BC-M4	2200	450
220	G.E. 3 brg. .8 PF	ATI	220/440	600
200	G.E. .8 PF	ATI	220/440	900
150	Gen. Elec. .8 PF	ATI	2200	450
150	Gen. Elec.	ATI	220/440	300
125	Whse.	G	2300	900
125	G.E. splprf. .8 PF	TS955	220/440	1200
125	Gen. Elec.	ATI	220/440	900
100	American b.b.	YGH	220/440	900

A. C. MOTORS—SQUIRREL CAGE

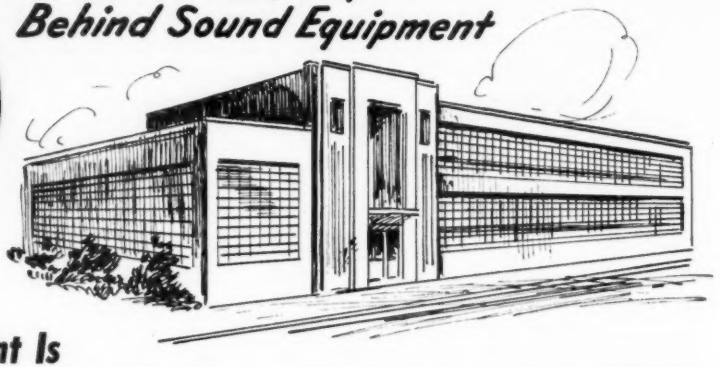
3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	300	Gen. Elec.	IK-16	1200
1—	250	Gen. Elec.	KT563	900
2—	200	Reliance b.b. NEW	C6085	1800
1—	200	Allis Ch.	AN	1200
1—	150	Gen. Elec.	I-K-16	600
1—	150	Reliance b.b. NEW	14C6085	720
1—	150	Whse. 2200 V.	CS771-1C	1800
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Gen. Elec.	IK-15	900
1—	150	Reliance b.b. NEW	B6085	900
1—	125	Reliance b.b. NEW	C5085	1200
2—	125	Allis Ch. 2200 V.	AN	1200
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200 V. b.b.	SC	1800
2—	125	Rel. TEFC NEW	B6085	1800
1—	100	Gen. Elec.	I-K	1800
5—	100	Allis Ch. 2200 V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Elec. Machy.	b.b.	1200
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	G.E. b.b. NEW	K5045	1800
1—	100	Cont. TEFC	NP982	1200
1—	75	Gen. Elec.	I-K 14	720
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Gen. Elec.	KT552	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	3600
2—	75	Reliance b.b. NEW	C505	1200
1—	75	Gen. Elec.	KT347	1200
1—	60	Gen. Elec.	KT552	720
1—	60	Gen. Elec.	KT346	900
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Rel. TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
3—	60	Whse. H.T.	CS3504	1800
1—	50	Wagner b.b.	RF444	3600
1—	50	Whse. b.b. NEW	CS4053	1800
1—	50	G.E. 2 phase	I-Q	900
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. hubip	WL607	900
2—	40	Gen. Elec.	KT527	1800
1—	40	Al. Ch. 3 speed	ARX	900/600/450
2—	40	Gen. Elec.	KT336	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Rel. TEFC NEW	C445	1200
2—	40	G.E.	KT532	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. speed	SC	1800
2—	30	G.E. NEW b.b.	K365	1800
2—	30	G.E. NEW hit-ry	KG365	1800
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22TsP	900
1—	30	Whse.	CS646	900
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C444	1200
1—	30	Cr. Wheeler b.b.	SC30Y	1800
2—	25	Gen. Elec.	KT326	1200
2—	25	Rel. TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
3—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
1—	20	Reliance b.b. NEW	C404	900
1—	20	G.E. TEFC b.b.	K404	1200
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp. pr.	EX364	1800
2—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
1—	20	Whse.	CS	1200
2—	20	G.E. NEW b.b.	K365	1200
2—	20	Diehl TEFC NEW	1NF364	1800
2—	20	Century b.b. 4 speed	SC594	1800
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Whse. NEW TEFC	CS326	1800
1—	15	Gen. Elec.	KT512	900

ARTHUR WAGNER COMPANY

1435 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 6-7409

A Sound Company Behind Sound Equipment



Where Hemphill Electrical Equipment Is REBUILT — THEN TESTED BY ELECTRICAL ENGINEERS

NO ITEM OF HEMPHILL REBUILT EQUIPMENT IS SHIPPED TO THE BUYER UNTIL TESTS PROVE THAT IT WILL GIVE YOU PERFECT SERVICE

TRANSFORMERS

1—1000 KVA G.E., 3 Ph. auto 4150V.—2300V.
1— 500 KVA Kuhlman 4150 V Pri. 2300 V. Sec.
3— 400 KVA G.E., 6900 Primary—2300 Secondary
3— 300 KVA Pitts., 2300 V. Pri., 115/230 V. Sec.
3— 300 KVA, G.E., type H, 2300 V Pri., 115/230 V. Sec.
300 KVA, Pitts., 7800-440 v.
205 KVA, Whse., 2 ph., 2300 to 3 ph., 4150 auto.
200 KVA, 4000 v.—110/220
100 KVA, Pitts., 1375/2750 v. —110/220.
3— 100 KVA G.E. 4150 volt 230/460 volt Pyranol
3— 100 KVA, Wagners, 240/120 v.—120 v.
2— 100 KVA, Newark, 440 v., 3 ph. to 220 V., 2 ph.
2— 100 KVA, Whse., 13800 v. to 250 v.
3— 75 KVA, G.E., 2400 v.—120/240
6— 50 KVA, Whse., 2400 v.—120/240 inerteen
6— 50 KVA Whse., 13,800 v. to 125 v. or 250 v.
6— 50 KVA, Whse., 6900 v. to 125 v. or 250 v.

A. C. GENERATORS

2500 KVA, Whse., Syn. Cond., 720 RPM, 2400 v.
500 KW, .8 P.F., 3600 RPM, ATB, 600 v.
320 KW, Allis, 450 RPM, 480 v.
240 KW, G.E., ATB, 600 RPM, 600 v.
200 KVA, Allis, 3600 RPM, 240 volt
200 KVA, Whse., 600 RPM, 240 v.
180 KW, Whse., 514 RPM, 550 v.
100 KW, G.E. ATB, 600 RPM, 240 v.
75 KW, Whse., 900 RPM, 220 v.
62½ KW, Allis, 3600 RPM, 220 v.
7— 50 KVA, Whse., 900 RPM, 220 v.
3— 35 KWA, Columbia, 1200 RPM, 240 v.
1— 31.3 KVA, America, 1200 RPM, 120-208.
15 KW, Star, 1800 RPM, 220/440.
12.5 KVA, Whse., 1200 RPM, 240 v.

TURBINE BLOWERS

1—Spencer, 1000 cubic feet, 30 oz. pressure with a 15 H.P., 3600 RPM, General Electric Type FT 200 volt motor
1—Bellmore, 550 cubic feet, 7 inch vacuum, with a 20 H.P. 3600 RPM, General Electric Type K, 220 volt 3 phase motor

MOTORS, 3 Phase, 60 Cycles
SQUIRREL CAGE

450 H.P., Ridgeway, 900 RPM, 2200 volts.
125 H.P., G.E., KF, 1750 RPM, 2200 v.
125 H.P., U.S., 1200 RPM, Vert., 220 volts.
100 H.P., G.E., 400 RPM, 440 volt.
75 H.P., West., CS, 1750 RPM, 440 volts.
60 H.P., Whse., 900 RPM, Vert., 2200 volts.
60 H.P., Whse., 900 RPM, 440 volts.
2— 40 H.P., G.E., 900 RPM, 220 volts.
10/20 H.P., Westinghouse 600/450 440 volt.
35 H.P., Whse., 1200 RPM, CS, 2200 volts.

MOTORS, 3 Phase, 60 Cycles
SLIP RING

2500 H.P., G.E., 257 RPM, 6600 volts.
450 H.P., G.E., 425 RPM, ITC, 440 volts, 25 cycle.
2— 150 H.P., G.E., 1M, 440 volt, 450 RPM.
100 H.P., G.E., 1M, 440 volt, 25 cycle, 720 RPM.
1— 100 H.P., G.E., 1M, 440 V. 400 RPM.
75 H.P., Whse., CW, 720 RPM, 440 volt.
75 H.P., G.E., MT, 1200 RPM, Vert.
50 H.P., G.E., MT, 600 RPM, 220 volts.
2— 50 H.P., Whse., CW, 900 RPM, 220 volts.
40 H.P. Cont., 1200 RPM, JAS7 220 volt.

AIR COMPRESSOR

312 CFM, I-R Model 75, 2 stage, 900 RPM, 100.2 with 75 H.P. Squirrel Cage Mtr.

DIESEL GENERATOR SETS

3—300 KW 125/250 V. De La Vergne Baldwin 6 cyl. 4 cycle with Westinghouse generators

LARGE STOCK OF D. C. MOTORS AND GENERATORS
SYNCHRONOUS MOTORS

1—200/100 H.P., Whse., 720/360 RPM, 4150 v.
200 H.P., Whse., 600 RPM, 240 v.
1—200 H.P., G.E., 257 RPM, 440 volt.
1—150 H.P., G.E., 1800 RPM, 220 v. TS
2—150 H.P., Allis-Chalmers 360 RPM, 2200 V.
75 H.P., G.E., 1200 RPM, 440 v.
70 H.P., Elect. Mach., 180 RPM, 2200 v.
40 H.P., Whse., 1800 RPM, 220 v.
35 H.P., G.E., 1200 RPM, 2200 v.
20 H.P., Whse., 1800 RPM, 220 v.

MOTOR GEN. SETS

1—1000 KW., Whse., 275 V.—4150—720 RPM, Syn.
1—1000 KW, G.E., 600 volts—4150—514 rpm, Syn.
1— 400 KW, G.E., 250 V. 900 RPM, 2300 V. Syn.
1— 500 KW., G.E., 575 V. 900 RPM, 2300 V. Syn.
125 KW., CW, 125 v., 1200 RPM, 2300 v. sq. cage.
100 KW., El. Mach., 125 v., 1200 RPM, 4150 v. syn.
100 KW, G.E., 230 v., 900 RPM 4150 v. Syn.
2— 75 KW., G.E., 125 v., 1200 RPM, 220/440 v.
6— 75 KW., G.E., 60 v., 1200 RPM, 220/440 v.
50 KW., Ridgeway, 550 v., 1200 RPM, 220 v.
25 KW., G.E. ATI, 1800 RPM, 40 HP, 1800 RPM, 230 v.

PLATING M.G. SETS

250 Amp. G.E., 5/6 volt, 220 v.
500 Amp., Hansen Van Winkle, 24 volt, 220/440 v.
2500 Amp., Chandeysson, 6/12 v., 400 RPM, Syn., 440 v.
3000 Amp., Chandeysson, 6/12, 400 RPM, syn., 440 v.

ENGINE GEN. SETS

150 KVA, G.E., Ames Uniflow, 220 v., 3 ph., non cond.
2— 5 KW, Gasoline, Hobart, 1800 RPM, 120 v., 1 ph. cont. engines.
1—200/275 H.P., Gasoline Engine, Van Blerck, 8 cylinder, 1500/900 rpm.

TURBO GEN. SETS

625 KVA, Whse. 2400 v., 3 phase, non-con.
300 KW, G.E., ATB, 240 v., 3 ph. cond.
60 KW, Whse., 120 v., D.C., cond.

STEAM TURBINES

500 HP., G.E., 2 stage, 165#, 3240 RPM.
800 HP., Terry Tandem type, 720 RPM. red. gear.

A GUARANTEE IS NO BETTER THAN THE COMPANY THAT GIVES IT — IT PAYS TO GET A *HEMPHILL* GUARANTEE

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J. L. HEMPHILL & CO.

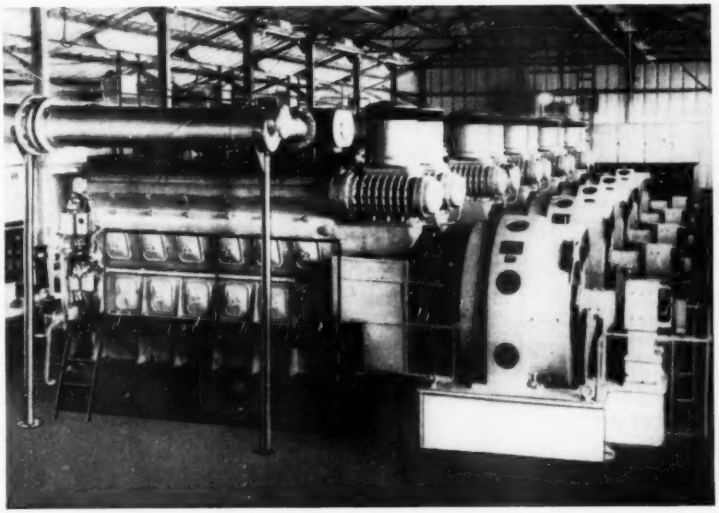
1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

Another AGSCO DIESEL POWER INSTALLATION

FIVE 720KW GMC UNITS "ON THE LINE" IN ENGLAND



Remanufactured and Tested at Our SAUSALITO (San Francisco) CALIF. Shops, These Five 1080BHP GMC Model 12-567 Diesel Engines Connected to 900KVA, 720KW G.E. Generators Are in Continuous Service at the Parkinson Strip Mining Co. Ltd., Bedington, ENGLAND.

Save on Initial Acquisition Costs with "AGSCO REMANUFACTURED DIESEL EQUIPMENT." Submit Your Power Requirements Today.

UNITS AVAILABLE FOR IMMEDIATE SHIPMENT

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1420	Fairbanks Morse	38D8 1/8	1600	720	312	General Motors	8-268A	450	1200
1250	General Motors	16-278A	1600	720	200	Buckeye	80	240	600
1000	General Motors	12-278A	1200	720	187	Ingersoll Rand	S	225	514
900	General Motors	12-567	1080	720	156	Buckeye	E	187	400
625	Alco	6-12 1/2x13T	750	600	125	General Motors	3-268A	150	1200
625	Baldwin	VO-8	750	514	75	General Motors	6043C	90	1200
625	Superior	OS	750	327	75	Fairbanks Morse	35E	90	450
425	Baldwin	VO-6	510	450	62	Int'l. Harvester	UD-18	76	1200
400	Buckeye	80	480	600	50	General Motors	4-71	60	1200
375	Enterprise	DSG-6	450	450	18	Int'l. Harvester	UD-6	22	1200

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

ESTABLISHED 1898

Diesel Engines • Power Machinery

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WHEN YOU BUY RE NU BILT BELYEA MOTORS FROM BELYEA

RE-NU-BILT EQUIPMENT

Rebuilt in accordance with N.I.S.A. Rebuilding Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	900	275	2300
1	1000	Whse.	900	600	2300/4150
1	1000	Whse	720	600	2300/4150
1	1000	West.	514	250	4150
1	1000	Whse.	514	600	4150
1	1000	Ck. Wh.	720	250	2300/4150
1	800	G.E. (SU)	1200	120/240	2300
2	750	Whse	900	250	2300
1	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
1	500	G.E.	900	250	2300/4600
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	100	G.E.	1170	125	220
1	100	G.E.	1200	250	2200

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720
1	3000	G.E.	ATI	4800	720

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—2000	G.E.	514	600	13800
1—2000	G.E.	450	600	2300
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 500	Whse.	900	250	2300

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse		600	525/720
2—1500	Whse.		525	660
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	250	115/145
1—500/400	G.E.	DYNA	250	1325/2500
1—335	Whse.	MQ	250	300/900
1—200/300	G.E.	MPC	230	380/920
1—275	Whse.	QM-400-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
1—150	Cr. Wh.	CCM	230	300/1050
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	890
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CO-1832	230	625
1—125	El. Dy.	308	230	750/1500
1—115	Cr. Wh.	JHL	230	1200
3—101	Whse.	8K	230	485/950
1—100	Rel.	1050T	270	400/1200
1—90	G.E.	CDM-1242Z	115	1800
1—50/100	G.E.	CD-173	250	365/730
2—80	El. Dy.	308	230	475/1350
1—75	Whse.	8K-100L	125	650
2—75	El. Dy.	25-8L	230	750/1750
3—60/75	Whse.	8K-200	115	300/700
4—75	Cr. Wh.	53-H	230	860
2—75	G.E.	CDM-1126Y	230	2000
1—60	Whse.	8K-160	550	880
1—60	El. Dy.	25-8	230	525/1050
1—60	Whse.	8K	230	500/1000
1—60	Whse.	8K-131	230	500/1500
1—60	El. Dy.	258	230	750/1500
2—50	G.E.	RCP-31B	230	1700
4—50	Whse.	Holst	230	400
1—50	Whse.	8K-153	230	690/1035
1—50	Cr. Wh.	CMC-80H	230	380/750
3—40	Rel.	385 T "VS"	230	400/1500

with 40 KW MG sets, 230 v. DC, 230/440-3-60 Exciters and automatic "VS" control.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4800	514
2—2000	Whse.		2300	120
1—1000	Whse.		2300	180
2— 900	Al. Ch.	(New)	2200	150
1— 600	Whse.	Syn.	440	360
1— 500	G.E.	ATI	480	900
2— 500	G.E.	TS	4150	600
1— 450	Whse.	Eng.	2200	128.5
2— 350	G.E.	TS	2200	150
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600
1— 145	G.E.	ATI	550	720
2— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600
2— 100	G.E.	TS-7651	440	450
1— 100	G.E.	TS	440	1800
1— 100	E.M.	Unused	440	600

SLIP RING

1—1000	Whse	CW	2300	700
2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM-Mill	2200	450
3— 450	G.E.	IM	440	506
1— 400	G.E.	IM	440	720
3— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
1— 300	G.E.	IM	440	720
9— 300	Al. Ch.	ANY	2200	708
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-5598	2200	1750
1— 155	G.E.	IM	2300	7-0
4— 100	GE	MT-566Y	440/2200	425
2— 100	G.E.	IM-16	2200	435
3— 100	Al. Ch.	AK	2200	1200
1— 75	Whse.	CW-761	2300	1750
1— 60	Cr. Wh	123-AQ	220	700
2— 50	Whse.	CI-638A	220	870
2— 50	Whse.	CIW-504	440	870

SQUIRREL CAGE

1— 250	G.E.	KT-559	440	1800
1— 200	G.E.	IK	550	865
1— 200	G.E.	KT-557	440	1800
1— 150/50	Whse.	CS	440	879/343
1— 125	Whse.	MS	440	485
1— 125	(New) G.E.	KF-TEFC	440	1199
1— 125	G.E.	KF-TEFC	440	3585
1— 100	G.E.	IK	440	575
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750
1—60/20	Whse.	CS	220	900/450

FREQUENCY CHANGER SETS

1—1000 KW—Al. Ch. Consisting of 1400 HP. 2300 V. 3 ph. 25 cy. Motor and 1000 K. 2300 V. 3 ph. 62½ cy. gen. switch exciter

1—1000 KW—GE—2 unit—3 Brg. Consisting of—1400 HP—4400 V., 3 ph. 25 cy. Motor and 1000 KW—2300 V. 2 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW 3 ph.)

1—320 KW—GE—2 Unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., 8 pf. Syn. Motor and 400 KVA, 8 pf, type AT—3 ph, 120 cy, 720 volt AC generator with direct connected exciter.

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

1—1000 KW—American B.B. Type GRZ-612—12 anode 625 V.D.C. with 1040 KVA O15C—3 phase—13200/6600V-25/60 cycle transformer with full automatic switching equipment along with 2 distribution panels.

1—1000 KW—Al.Ch. type B-612—12 anode 625 V.D.C. with 1140 KVA O15C—3 phase—13500V.—60 cycle transformer with manually operated switching equipment along with voltage regulator and grid control.

Turbo Generators

See our advertisement on page 261

BELYEA CO INC.

Main Office and Shop

43 HOWELL ST., JERSEY CITY 6, N. J.
Phone—Journal Square 2-3334
Also N. Y. City Line—Rector 2-7150

GLOW

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh.
400	1200	440	GE-I-17
350	3550	2200	Westgh.-CS
350	514	440	GE-I
300	900	440	GE-I-17
250	1200	440	GE-KTR
250	600	2300	Triumph
225	514	440	GE-I-14
200	490	2200	GE
200	600	440	Westg'h-CS
150	600	2200	GE
125	1200	440	Century
125	340	220	A-C
100	1800	2300	Burke
85	3600	2200	GE
75	1800	220/440	GE-K505S
75	900	2300	GE
60	3600	2300	GE-KT
60	1800	220/440	A-C, AR
60	1800	2300	GE-FTR
50	3600	440	R. & M.
50	1800	220	Triumph
50	900	220	GE
50	720	2300	Wtg.-CS
40	900	2300	Wtg.-CS
40	720	440	GE-KT
30	1200	dual	Master
30	900	220	A1-Ch.-AR fr. 220c
30	900	220	Wagner (Hi-Torque)
30	720	220	GE-HJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	dual	GE
25	1200	220	Wesche
25	900	440	GE
25	900	220	Westgh.-CS
25	720	220	Wagner
25	600	440	GE-I
20	3500	440	Al.-Ch.
20*	1800	220/440	Master
20*	1800	220/440	Weache
20	1200	440	Al. Ch.
20	900	440	Wtg.-CCL
20	600	220	GE-KT

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
75	1200	2200	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1800	dual	Delco
15	1200	220/440	Delco-TEFC-BB
15	900	440	GE-TE-FC-BB
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-Hi Slip-TEFC-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-Hi Slip
7½	900	dual	Delco-TEFC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	dual	Delco, TE-FC-BB
3	1800	dual	Delco-TEFC-BB
3	1200	dual	Rel-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB

*New Motor

ENCLOSED SQUIRREL CAGE—Cont'd.

HP	RPM	Volts	Make
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al-TE-BB
1½	1200	dual	Delco-TEFC-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1	1200	220	GE-KT
¾	3600	4400	Delco-TE
¾	1800	dual	Wesche-TE-BB
¾	900	dual	Delco-TEFC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco.-TE-BB
½	1200	220	Cr.W h-TE
½	900	dual	Delco-TE
1/3	1800	440	Delco-TE

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
400*	514	2300	C-W Short Shaft
375	1800	2300	Al. Ch.
350	900	2300	Westgh.
300	720	2300	Al. Ch.
300	708	2200	Al. Ch.
250	800	2300	Al. Ch.
235	1800	220	GE-I
75	1800	220	GE
75	900	440	Al.-Ch., ANY
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	GE-MT-336
40	720	2300	Wtg.-HF
40	720	220	Al. Ch.-ARY
40	600	2300	Al. Ch.-ARY
40	600	220	Al. Ch.-ARY
40	450	220	Triumph-C
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE
35	900	2200	GE
30	1800	2300	Wtg.-CW
30	1800	220	GE
30	1200	440	Wagner
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	F-M
30	720	220	GE-I
30	600	220	F. Morse-BV
25	1200	220	Wesche
25	900	220	Watson

*New Motor

VERTICAL MOTORS

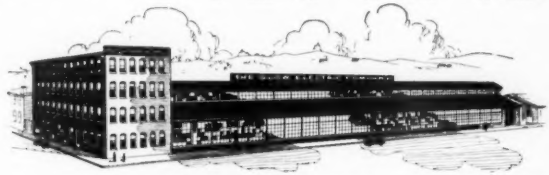
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2200	GE-I-SR
150	1200	440	GE-Cage
125	1200	2300	Al. Ch.-SR
125	1200	2300	Al.Ch.-Cage
100	1200	440	GE-Cage
75	1200	dual	Westgh.-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60*	1200	440	Al. Ch.-Cage

VERTICAL MOTORS—Cont'd.

HP	RPM	Volts	Make
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	2200	Westgh.-BB-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg
20*	1200	440	Al. Ch.-Cage
20	800	330 D.C.	GE-RC
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	115 D.C.	R & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	3600	dual	Delco
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg.-25 cycle
710	720	13200/6600	GE
500	514	440	GE
435	720	2300	GE TYPE ATI
320	900	2300	GE-ATI
250	225	2200	GE-TS
220	600	2300	GE-ATI
200	720	440	GE-TS
200	225	2300	Wtg., rotor & stator only
160	800	440	GE-ATI
150	1800	2200	GE
150	1800	220	GE-ATI, Single Bearing
150	720	440	Westgh.
120	225	2200	E-M, rotor & stator only
115	164	208	GE
95	1200	220	Burke
75	1200	220	Westgh.
75	900	2300	GE-ATI-7552
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh.
50	720	440	GE-TS
50	360	440	GE, rotor & stator
50	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg., rotor & stator
30	360	550	GE
30	327	220	E-N, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
25	300	220	Ideal
20	1200	440	Wagner
20	900	220	Wtg.
20	600	220	E-M, rotor & stator
15	1800	220	Wagner
15	1200	440	Wagner
10	1800	220	Wagner
10	1200	220	Wagner



D. C. MOTORS

115 Volts

HP	RPM	Description
25	750	GE-MPC
60	1200	Star
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr. 202A
18	600	Sturtevant MP8
15	1200	J. & L.
15	1000	GE-CE
15	975	F-M
15	725	Westgh.-S fr 6
12½	1150	GE-RC29
12	1075	J. & L.
12	530	Westgh.-SK-113
10	3450	Imperial
10	1800/3400	Star, SB-5
10	1200	J. & L.-CI
10	650	J. & L., type CI
10	400/1600	Watson-BW13B

SPECIAL SUB-STATION

G. E. Double ended Load Center, Unit Sub-Station complete with:

2 Pyranol Filled, indoor type transformers each rated 1000 KVA, 13800 volts primary, 460 volts secondary, 3 phase, 60 cycle, and each having a liquid filled disconnect switch.

3 G. E., type AL-2, 1600 amp., 50000 amp. RMS, Air Circuit Breakers.

12 G.E., type AE1B, 600 amp. Air Circuit Breakers of draw out type.

Switchgear latest type metal clad.

D. C. GENERATORS

125 Volts

KW	RPM	Description
300	750	GE-MCF
300	1500	GE-CC
200	900	GE-MPC
200	800	WE-DMC
100	1000	WE-DLC
100	900	C-W-CCD
80	400	J. & L.-G
65	1100	W-E, type ELC-7
55	1000	GE-Type TD
40	600	J. & L.-F Ped. Type
3o	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing

D. C. GENERATORS

250 Volts

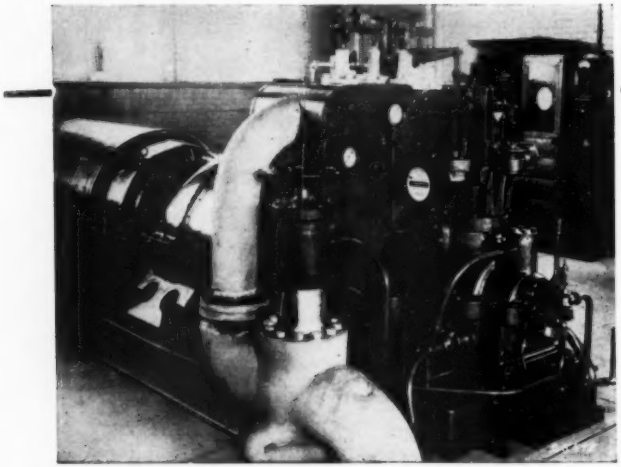
KW	RPM	Description
400	1200	Westgh.
200	1200	GE-MPC
200	375	J. & L.-type K
175	450	Westgh.
125	1400	Westgh.-SK-130L
80	1050	GE-DLC
75	1400	Burke
75	700	Allis-Chalmers-E180
50	1200	Al. Ch.-E-127
35	1800	GE-RC
30	300	Triumph
22½	765	Westgh.-SK
18	300	Burke
15	350	Westgh.-SK

ELECTRIC CO.

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

927 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

Generate Your Own Power With "UTILITIES APPROVED" EQUIPMENT



Greater Values—Prompt Delivery

STRICTLY UTILITY, EFFICIENT WESTINGHOUSE CONDENSING STEAM TURBO-GENERATOR UNIT

AVAILABLE IMMEDIATE SHIPMENT

Westinghouse, 3600 RPM condensing steam turbo generator unit consisting of:

TURBINE

1500 KW, 250 P.S.I., 150° S.H. 28 inch vacuum direct connected to:

ALTERNATING CURRENT GENERATOR

1875 KVA, 1500 KW, 80% P.F. 3 phase, 60 cycle, 2400 volt 451 Amp. complete and equipped with:

ACCESSORIES

2700 square foot Westinghouse surface condenser, condensing auxiliaries, piping, valves, duplicate exciter sets, switchboard panels and instruments.

EXCELLENT CONDITION

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

6250 KVA G.E. condens., 5 stage, 2300/4000 volts, 200# pressure, 600°TT, 3600 RPM, complete with exciter, switchboard and surface condenser.

5000 KVA G.E., non-condensing Automatic Extraction, 3 phase, 60 cycle, 13,800 volts, 600# P.S.I., 750°TT 150# extraction and 25# gauge back.

3125 KVA G.E. condensing 175/200 P.S.I. 2300 volt, 500°TT, 3600 RPM complete panel.

1875 KVA G.E. non-condensing 150# pressure, 30# gauge back, good for maximum 260#, 650°TT, 480 volts, 3600 RPM, exciter, switchboard, a complete installation.

625 KVA Westinghouse condensing 150/200# pressure, 2300 volt, 3600 RPM complete.

625 KVA G.E. non-condensing 150# pressure, 15# back, 2300 volts, 3600 RPM complete.

375 KVA (4) G.E. condensing 400# pressure, 2300/4150 volts each complete exciter, switchboard, condenser.

100 KVA Westg. non-condensing 125 to 150 lbs. pressure, 10# gauge back, 2400 volts, 3600 RPM.

TURBINE-GENERATOR UNITS

Direct Current

400 KW (2) 240 volts direct current Crocker-Wheeler Worthington 440 lbs. pressure condensing.

200 KW (3) New General Electric 200/250# pressure, 120 volts condensing.

150 KW (2) 3 wire, 250 volts, 225/250 psi, Westinghouse-Worthington condensing.

75 KW Allis-Chalmers-Terry, 125 volts, 2400 RPM, 150 lbs. pressure non-condensing.

60 KW (3) new Westinghouse 120 volt, 200# pressure, condensing.

SYNCHRONOUS MOTORS

300 HP 80% P.F. G.E. type ATI, 2300 volts, 720 RPM synchronous motor.

900 HP Allis, 3 phase, 60 cycle, 2200 volts, 150 RPM synchronous motor.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase 60 cycle 4000/6600 volts synchronous motor.

500 KW General Electric 600 volt DC, direct connected to 710 HP General Electric, 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW General Electric 275 volt DC, direct connected to 710 HP General Electric, 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

300 KW Allis-Chalmers, 250 volt DC generator direct connected to a 430 HP Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1200 RPM synchronous motor.

62½ KVA G.E., 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP, 125 volt DC motor.

50 KW Westg. 125 volt, 1200 RPM direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

ROTARY CONVERTERS

500 KW (2) 6 phase, 60 cycle, 600 volts direct current, 1200 RPM West. sy. converters.

2000 KW, 6 phase, 25 cycle, 270 volts, 7410 amps., D.C., 300 RPM West. rotary converter.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW G.E. 240 volts, 360 RPM generator connected to Skinner Unaflow vertical non-condensing engine, 150 lbs. pressure, 10 lbs. gauge back.

275 KW Westinghouse 250 volt, 350 RPM generator connected Ames vertical Unaflow engine.

200 KW, G.E. 125 volt, 200 RPM generator connected Skinner Unaflow engine.

STEAM ENGINE-GENERATOR UNITS

Alternating Current—3 Phase 60 Cycle

750 KVA G.E. 2300/480 volt, 150 RPM generator, connected Skinner Horizontal Unaflow non-condensing engine.

500 KVA G.E. 240 volt, 360 RPM generator connected Skinner Vertical Unaflow engine.

156 KVA, 240 volts, 240 RPM generator connected to 17"x16" Skinner Counterflow engine.

125 KVA Westinghouse 240 volt, 257 RPM generator connected to Ames Unaflow engine.

DIESEL ENGINES

900 HP (10) General Motors, Model 12-567 ATL, 12 cylinders, 744 RPM Diesel engines complete with auxiliaries.

1200 HP (4) Fairbanks-Morse, 8 cylinders, opposed piston, 720 RPM Diesel engines.

UTILITIES MACHINERY CORPORATION

East 6th and Euclid Ave. LONG DISTANCE 422 **Cleveland 14, Ohio**

POWER EQUIPMENT—READY TO SHIP

SAVE OVER 50% ON NEW INDUSTRIAL BLOWERS AND VENTILATING FANS

AXIAL FLOW VENTILATING FANS

1—16000 CFM Buffalo Forge Co., 3" stat. pres. 1800/1200 rpm. con. 15/4.5 HP., 1710/1150 rpm., 3 ph. 60 cy. G.E. A.C. Motor 220/440 v. totally enel.
1—12000 CFM 3" stat. pres. Sturtevant with dir. con. 10/3 HP., 1775/1150 rpm., 220/440 v. West. CS. TEFC Motor.
25—6000 cfm Sturtevant Bulletin 512389, 3" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.
2—5000 cfm Sturtevant 1.8 stat. pres. 4.2/1.25 HP., 1750/1150 rpm., 3 ph. 60 cy. 220/440 v. ball bearing motors.
2—4000 cfm 3" stat. pres. Sturtevant dir. con. 2 speed, TE Westinghouse 220/440 v. Motors.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westinghouse Reduction Gear. — Non-condensing.

A.C. MOTORS—3 PH. 60 CY.

No.	H.P.	Make	Type	RPM	Volts
1 NEW	500	Elec. Mach.	Syn.	120	4000/2200 220/440
1 NEW	200	Westing.	Syn.	1200	220/440
2	300	G.E.	IE	1200	2300
2 Vert.	250	G.E.		1200	2200
2	200	Westing.	CS	900	2300/4000
1	200	G.E.	Syn.	1800	2300/440/220
1	175	Westing.	Hi-torq.	1200	220/440
1	150	Westing.	Syn.	257	220/440
1	150	Westing.	Syn.	450	220/440
1	150	Westing.	CS-954A	580	4000/2300
3	150	Westing.	CS-854S	580	220/440
1	150	Westing.	MS	1200	220/440
3	150	Louis Allis splash proof	FX	180	220/440
1	125	Elec. Mach.	Syn.	164	220/440
1 NEW	125	Elec. Mach.		585	4160/2300
1	125	Westing.	CS	690	220/440
1	125	G.E.	IK	900	440/220
1 TEFC	125	Westing.	CS	3600	220/440
1	100	Reliance	IT	495	220/440
1	100	Westing.	CS	580	220/440
1	100	G.E.	IK	720	220/440
1 Vert.	100	G.E.	XPR	885	220/440
1	100	Wagner		850	220/440
1	100	Westing.	Syn.	900	220/440
1	100	Westing.		1200	220/440
2 TEFC	100	Master	PA	1750	220/440
1	100	Armour	AB	1750	220/440
1	100	Louis Allis splash proof	OGS	1750	220/440
1	75	Stanley		600	220/440
1	75	Chandey	Syn.	600	220/440
1	75	G.E.	IK	600	220/440
1	75	G.E.	KF	900	220/440
1	75	Elec. Mach.	Syn.	900	220/440
1	75	G.E.		720	220/440
1	75	G.E.	KT	1150	220/440
1	75	Louis Allis	Hi. Torq. splash pr.	1150	220/440
1	75	Westg.	TEFC	1750	220/440
2	60	G.E.	IK	600	220/440
1	60	G.E.	KF	700	220/440
1	60	Burke	EM	900	220/440
3	60	G.E.	KT	900	220/440
2	60	Westg.	CS	900	220/440
3	60	Westg.	CS	1200	220/440
1	60	G.E.	KT	1800	220/440

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA	Make	RPM	Volts
1 new	450	Elec. Mach.	120	4000/220 220/440
1 new	250	West.	1200	220/440
1	100	Elec. Mach.	164	220/440
1	100	West.	600	220/440
1	75	Elec. Mach.	900	200/440
1	50	G.E.	1200	220/440
1 new	50	Elec. Mach.	1200	220/440
1	37½	Ft. Wayne	1200	200/440
1 new	25	G.E.	900	220/440
	25	O'Nan	1800	220/440

BARGAINS FOR SALE
100 KW. Diesel Engine
Generator Sets

11—100 KW., 250/275 V. D.C. Delco Generators dir. con. to 150 HP. Model GBD-8, 5½x7, 8 cyl. Superior Diesel Engines, elec. starting with muffler, power panel and accessories.
1—100 KW., same as above with 220 or 440 V., New A.C. Generators.
2—37½ KVA. 220/440 V. 3 ph. 60 cy. Buda Lanova Diesel.
3—25 KVA. West 1 ph. or 3 ph. Al Le Roi Gasoline.
3—NEW 7½ KVA. 3 ph. 60 cy. 1800 rpm. Wisconsin Gas Engines.
2—NEW 5 KVA. 1 ph. 60 cy. Wisconsin Engine Sets.

250 VOLT D.C. GENERATORS

No.	KW	Make	Type	RPM
3	250	West.		1200
1	200	West.	SK	500
1	110	West.	SK-190	700
8	100	Reliance	1050-T	580
1	100	West.	SK-183	720
1	100	West.	SK-190	720
1	100	West.	SK-180	900
6	100	Delco		1200
1	100	G.E.	RC-58	850
1	100	West.	SK	850
1	100	G.E.	RCP-36	2100
1	75	Allis Chal.		850
2	75	West.	SK	1400
1	60	West.	SK	2100/1950
1	60	West.	SK-153	1100
1	50	West.	SK-180	400
1	50	G.E.	DLC-203	850
1	50	West.	SK-143	1100

MOTOR GENERATOR SETS—
250 V.D.C.
Motors 220/440 volt or 2200 volt
3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200
2	90	Westinghouse	680
4	75	Westinghouse	730
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 NEW	50	General Electric	1800
3	40	Westinghouse	900
2	30	Westinghouse	720

125 V. DC M.G. Sets

1—100 kw. G.E. 125 v. 900 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.
1—125 kw. G.E. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. AC.
1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

VARIABLE SPEED MOTORS—
230 V. D.C.

No.	HP	Make	Type	RPM
1	200	West.	SK	500/1000
6	100	Reliance	1050-T	400/1000
1	100	G.E.	RC	650/1200
2	100	West.	SK-183-A	575/1150
1	100	West.	SK-190	500/1000
1	100	West.	SK	600/1200
1	75	West.	SK	1100/1800
2	75	West.	SK	850/1700
1	50	West.	SK-180	330/900
1	50	West.	SK	300/1200
1	50	West.	SK-191	350/1050
1	50	West.	SK-143	850/1750
1	40	Allis Cha.		400/1300
2	30	G.E.	DLE-50	400/1200
1	30	G.E.		800/1200
1	25	G.E.	CD-122	300/1200
1	20	West.	SK-123	400/1600
1	20	G.E.	RF-11	500/1500

SLIP RING MOTORS—3 ph. 60 cy.

No.	H.P.	Make	RPM	Volts
1	1000	G.E.-MT	900	2200/440
1	800	G.E.-MT	900	2200/440
2	800	West. CW	507	6600
1	600	G.E.-MT-415	900	2200/4000/220/440
1	350	West. CI	1150	220/440
1	250	Allis Chal.	870	2200
1	250	West. CI	1150	220/440
1	250	West. CW	1800	220/440
1	200	West. CW	1800	220/440
1	150	West. CW	1150	2200/220/440
1	125	West. CW	860	2200/220/440
1	100	West. CW	720	2200/220/440
1	100	Triumph C-17	580	550/440/220
1	75	G.E.-M	720	220/440
1	75	West. CW	1800	220/440
1	60	West. CW	900	220/440
1	60	G.E. IM	720	220/440
4	50	West. CW	870	2200/220/440

25 CYCLE A. C. MOTORS
3 ph. — 220-440 volts

H.P.	Make	Type	RPM
500	G.E.	MT	375
300	G.E.	MT	375
300	G.E.	MT-415	375
150	West.	CW	400
75	West.	MS	400
75	G.E.	M	715
60	West.	CS	1450
50	L. Allis	OGS-115	730
50	Armour	AB-1	720
50	West.		475
40	West.		725
25	West.	MS	715
20	West.	CS	715
20	Allis Chal.		715

TRANSFORMERS—1 ph. 60 cy.

No.	KVA	Make	Pri.	Sec.
1	500	Standard	2300	575/460/345 /230/115
1	300	Phg.	2200	110/220
1	100	Peerless	2300	230/460
3	75	West.	2300	230/460
1	75	Al. Ch.	2300	230/460 (3 ph.)
1	75	West.	13200/6600	2300
3	50	West.	2200	110/220
3	37½	Packard	2200	110/220
3new	25	Al. Ch.	440	110/220

FREQUENCY CHANGERS

1—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir. con. to 25 HP., 1800 rpm, 220/440 v. 3 ph. 60 cy. motors.

SYNCHRONOUS MOTORS

1—New 500 HP., Elec. Machy. Co. 2200/220 or 440 v. 120 rpm.

ENGINE GENERATOR SETS

10—NEW 1 kw. 14.25 v. D.C. and 2 kw., 28.5 v. D.C. Homelite portable gas eng. Gen. sets. Can furnish lamps and batteries. Suitable for farms and camps.
1—125 kva. 220/440 v. 3 ph. 60 cy. 257 rpm., Erie Ball STEAM.
1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.

HOISTS or WINCHES

200—1½ Ton HAND CRANKED ratio 27:1 thru an enclosed double reduction gear unit with 4 planetary gears mounted on steel plate complete with 48' of ¼" cable, ratchet type brake, push button release.

GEAR HEAD MOTOR

50 HP., G.E. 220/440 or 550 v., 3 ph. 60 cy., 1755 to 13 rpm., splash proof, ball bearing.

SPECIAL BARGAIN
AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con., to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

"BREW, WOLTMAN OFFERS"

TURBINE UNITS

1—6375 KVA Cond. 50 cy. 13800 V. 600-lb. 825 deg. FTT. Surface Condenser & boiler. NEW.
1—5000 KVA G.E. Non-C. 60 cy. 13200 V. 600-lb
1—3750 KVA. West. Cond. 60 cy. 2300 V. 200-lb. Surface Condenser.
1—3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lbs., 40-lbs BP.
1—1875 KVA G.E. Cond. 60 cy. 2300 V. 140-150-lbs.
1—1875 KVA G.E. Non-C. 60 cy. 480 V. 175-200 lbs., 15-lbs. BP
1—1563 KVA G.E. Ext. 60 cy. 2300 V. 400-lbs. IP, 160-lbs. Ext. Cond.
1—1250 KVA DeLaval Non-C 60 cy. 2300 V. 250-lbs.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 150-200-lbs.
1—1250 KVA West. Non-C. 60 cy. 2300 V. 275-lbs.
1— 940 KVA Elliott Cond. 60 cy. 480 V. 400-lbs.
1— 187 KVA G.E. Non-C. 60 cy. 480 V. 375-lbs., 100-lbs. BP.
1— 125 KVA West. Non-C 60 cy. 240/480 V. 150-lbs., 5-lbs. BP.
1— 25 KW Allis Non-C. DC 125 V. Exciter Dual drive turbine & motor.

BOILERS

2—508 HP Casey Hedges Bent tube.
1—507 HP Comb. Engr. 400-lb. 620 deg. TT. Oil.
2—350 HP Union Iron Wks. 200-lb. box header. Oil.
2—253 HP B. & W. 225-lb. Bent tube.
2—200 HP Erie Economic 125-lb. Stokers.
1—180 HP Frost 200-lb. Return tubular.

DIESEL ENGINE UNITS

2—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
1— 720 HP Amer. Loco. 240 V. D.C.
1— 625 HP Worth. 240 V. 60 cy. gen.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP DeLaVergne 2400 V. 60 cy.
1— 375 HP Worth. 240 V. 60 cy. gen.
2— 240 HP Fair. Morse 2400 V. 60 cy.
1— 150 HP Gen. Motors 3-378A-60-3-480
2— 125 HP Murphy 240 V. 60 cy.

NEW
MOTORS
STOCK
20 — 200 HP
At greatly reduced prices

SYNCHRONOUS MOTORS—60 Cy.

2—3000 HP G. E. 2300 V. 257 RPM
1—1400 HP G. E. 4150 V. 514 RPM
1— 880 HP G. E. 6600 V. 514 RPM
1— 600 HP G. E. 440 V. 360 RPM
2— 500 HP E. M. 2200 V. 514 RPM
3— 400 HP E. M. 440 V. 600 RPM
1— 350 HP G. E. 440 V. 900 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
1— 250 HP West. 600 V. 180 RPM
1— 250 HP G. E. 550 V. 400 RPM
1— 200 HP G. E. 220 V. 600 RPM

INDUCTION MOTORS—60 Cy.

1—8000 HP Cr. Wh. S/R 2200 V. 895 RPM
1—7200 HP S/R 11000 V. 750 RPM 25 cy.
1—1000 HP G. E. S/R 2200 V. 514 RPM
2— 450 HP West. S/C 4150 V. 360 RPM
1— 300 HP West. S/R 2200 V. 1770 RPM
1— 250 HP G. E. S/R 2200 V. 1800 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 900 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 720 RPM New.
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM. New.
1— 150 HP Cr. Wh. S/C 440 V. 1200 RPM. New.
1— 150 HP Cr. Wh. S/C 440 V. 900 RPM. New.

MOTOR GENERATOR SETS

2—1000 KW G. E. 600 V. DC 60 cy.
1— 500 KW G. E. 250 V. DC 60 cy.
1— 200 KW G. E. 60 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.
1— 18 KW West. 60 V. DC 60 cy.

ROTARIES—60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2025/2565 KW Gen. Elec. 225/285 V.
2—1500 KW Westinghouse 70 V.
1— 500 KW Westinghouse 250 V.

MERCURY ARC RECTIFIERS

2—1500 KW Ignitron 600 V. DC
1—1850 KW Ignitron 275 V. DC

FREQUENCY CHANGERS

1—12500 KVA G. E. 25/60 cy. 300 RPM
2— 3000 KVA West. 25/60 cy. 300 RPM
1— 2500 KVA G. E. 25/60 cy. 300 RPM
2— 1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS—60 Cy.

1—2000 KVA G. E.	69000—13800/23900 Y 3 ph.
3— 500 KVA G. E.	66000—13200/6600
3—2000 KVA West.	66000—11000
3—1000 KVA West.	66000—11000
1—7500 KVA Al. Ch.	33000—13800, 3 ph.
3— 250 KVA West.	33000/11000—6600
6— 50 KVA G.E.	33000—2300
6— 75 KVA Moloney	33000—2300/6900
3—3750 KVA West.	26400/13200—2400
4— 450 KVA Al. Ch.	25410/4400—13280/23000 Y
3—1667 KVA Wagner	23000—575/2300, 25 cy.
3— 250 KVA West.	22000—2300/4150
1— 750 KVA G. E.	13200—480, 3 ph., Unit Substation
2— 200 KVA G. E.	11500—220/110
3— 200 KVA Moloney	11000—2300
3— 167 KVA G. E.	7200/12400 Y—240/480
1—1500 KVA West. Auto	4000—2300, 3 ph.
3— 250 KVA Al. Ch.	2300—460
2— 20 KVA West.	220—575/287½
3— 7½ KVA G. E.	600—120/240
12— 15 KVA Standard	450/225—117/234
2—27½ KVA G. E.	440—220/110

OIL CIRCUIT BREAKERS

1— 400 A. 73 KV. G. E. FMKO-236		Outdoor
1— 400 A. 73 KV. G. E. FMKO-136		Outdoor
1— 600 A. 73 KV. G. E. FMKO-139		Outdoor
3— 400 A. 37 KV. West. G-11		Outdoor
1—1200 A. 25 KV G. E. FMKO-256		Outdoor
2—1000 A. 23 KV Kelman CB-76		Outdoor
4— 600 A. 15 KV. G. E. FMKO-138BS		Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street — New York City 7, New York

MOTOR GENERATORS

1—500 KW G.E. Syn. 600 V. DC. 900 RPM 440/2300/4000 V. AC. 3 P., 60 C.

1—400 KW West. Syn. 600 V. DC. 720 RPM 2300/4000 V. AC. 3 P., 60 C.

2—300 KW G.E. Syn. 250 V. DC. 1200 RPM 440/2300/4600 V. AC. 3 P., 60 C.

1—150 KW G.E. Syn. 250 V. DC. 1200 RPM 2300/4000 V. AC. 3 P., 60 C.

SYNCH. CONVERTERS

1—300 KW G.E. 600 V. 6 P., 60 C., 1200 RPM. 2300/4000/6900/13,200 V. Trans.

1—150 KW G.E. 250 V. 6 P., 60 C., 1200 RPM. 440/2300/4000 V. Trans.

WALLACE E. KIRK COMPANY
502 Grant Building, Pittsburgh, Pa.

BOILERS

2—404 H.P. sectional header oil burners
3—600 H.P. integral Furnace West. stokers complete plant with Thermix stacks. 1942
3—500 H.P. Stirling type low head. Spreader stokers, complete plant. 1942
1—200 H.P. Cyclotherm complete unit, oil tanks. 1947. 150#

HARRY BREARLEY
3423—91st Street, Jackson Heights, N. Y.

POWER PLANT EQUIPMENT
Special Offerings

TURBO-GENERATORS

2—New 4000 KW Cond. 2400/4160 V. 750° T.T.
1—3500 KW 2300 V Cond.
1—2500 KW 600 V Cond.
1—2500 KW 2300 V Cond.
1—3000 KW 600 V Cond.
1—2000 KW 600 V Cond.
1—1500 KW 2300 V Cond.
2—1250 KW 2300 V Cond.
1—1000 KW 2300 V Non-C.
2—1000 KW 440 V Cond.
1— 750 KW 600 V Extr.
1— 600 KW 240 V Cond.
1— 500 KW 600 V Cond.
1— 500 KW 240 V Non C.
1— 400 KW 480 V Non-C.
1— 350 KW 2300 V Non-C.

TURBO-GENERATORS (Continued)

1— 250 KW 240 V Non-C.
1— 150 KW 2300 V Non-C.
1— 125 KW 600 V Extrac.
1— 100 KW 600 V Non-C.
1— 50 KW 220 V Non-C.

TURBINE—Only

1—New 465 HP—3550 RPM —900 PSI.

DIESEL GENERATOR

1—New 1000 KW — 2400/4160 V.

ENGINE GENERATORS

1—500 KW 2300 V Unit.
1—400 KW 125 V Unit.
1—375 KW 2300 V Unit.
1—312 KVA 450 V Unit.
1—219 KVA 450 V Unit.
1—168 KW 220 V Unit.
1—168 KW 550 V

BOILERS

2—30,000# 425#
1— 550 HP 200#
1— 500 HP 400#
1— 300 HP 200#
1— 220 HP 160#
1— 200 HP 175#
6— 200 HP Sterling 160#
2— 190 HP 160# NEW
2— 510 HP Sterling 160#

AIR COMPRESSORS

1—6000 CFM 50# Motor
2—5600 CFM 50# Motor
1—4500 CFM 100# Motor
1—1300 CFM 100# Motor
1—6000 CFM 5.1# NEW
1—5000 CFM 10# Rotary Type Motor

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

The Buyers Must Be Satisfied—Always

LAND Guaranteed Electrical Equipment

1 YEAR GUARANTEE

RELIABLY REBUILT—DEPENDABLE EQUIPMENT

PARTIAL LISTINGS ONLY

Squirrel Cage Motors

H.P.	Make	Type	Speed
450	G.E. vert.	KF-6338	1180
250	G.E.	IK	1160
250	G.E.	K-568	575
200	G.E.	KF-6335Z	880
147	West.	25 cs	1750
125	Al. Ch.	AR-630F	450
100	G.E (2)	K-544	1175
100	West.	CS	870
100	G.E.	KT-556	865
100	West. (2)	CS	600
75	West.	CS-505S	1760
75	West.	CS-662-C	1150
75	West.	CS	670
60	West.	504-S	1750
60	Rel.	AA-C5084Z	870
60	West. (2)		900
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	G.E.	K-445	1170
50	West.	CS	800
40	G.E.	KT-336	900
40	West.	CS	900

Partial List Only!

Slipring Motors

H.P.	Make	Type	Speed
600	C. Wh.		514
200	G.E.	MTP	1800
200	G.E.	IM	1200
150	G.E.	MT-564Y	580
100	G.E.	IM	1800
100	Al. Ch.		690
75	G.E.	IM	870
75	G.E.	IM	690
60	Al. Ch.		690
60	G.E.	M-6326TEFC	855
50	West.	CW-554	1155
50	Al. Ch.	ARY	575
50	G.E.	M	575
50	G.E.	IM	490
40	G.E.	IM	1200

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
400	G.E. (4)	TS-9828	600
260	G.E.	TS	900
200	Ideal (2)		257
180	G.E.	ATI	900
150	G.E.	ATI	720
150	G.E	TS	1200
125	West.	G	1200
100	Elec. Prods.		1200

A.C. GENERATORS

K.W.	Make	Type	Speed
288	West.	G	900
75	G.E.	ATB	360
75	G.E.	ATB	1200

D.C. to A.C. Generators

K.W.	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

550 V. D.C. Motors

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1045/1350

230 V. D.C. Variable Speed Motors

H.P.	Make	Type	Speed
100	Rel.	1050-T	400/1200

230 V. D.C. Variable Speed Motors *(Continued)*

H.P.	Make	Type	Speed
75	G.E.	D	500/1500
75	Cr. Wh.	CMC-125H	375/750
60	G.E.	C	480/1100
55	Cr. Wh.	CCM-125H	165/500
50	West.	SK	500/1500
50	West.	SK	250/1000
40	Rel.	461T	400/1200
40	G.E.	CD-1441	400/1500
25	West.	SA	500/1500
25	Rel.	185-T	500/1500
25	G.E.	RF-13	400/1600
25	G.E.	RF-14	400/1200
25	G.E.	RF-14	300/1200
20	G.E. (6)	RF-12	400/1200
20	West.	SK	375, 1500
15/20	Rel. (4)	185-T	400/1600
15	West. (4)	SK-95	600/1500
15	E.D.		500/1500
15	West.	SK-12	350/1000
15	West.	SK	250/1000
15	West.	SK	500/1500
10	G.E.	RF-10	600/1800
10	G.E.	CD-83	600/1800
10	West.	SK	600/1200
10	West. (3)	SK	500/1500
10	G.E.	RF	400/1600
10	G.E. (3)	RF	400/1200
10	Rel.	131-T	250/1000
7½	West.	SK-70	500/1500
7½	G.E.	RF-10A	450/1600
7½	Al. Ch.		350/1050
5	West. (3)	SK-60	500/1500
5	G.E.	RF-9	450/1800
5	G.E.	RF	450/1800
5	Rel. (2)	46-T	400/1600

230 V. D.C. Motors

H.P.	Make	Type	Speed
150	G.E.	RC-19	800
125	G.E.	RC-15	1750
100	G.E.	RC-14	1750
100	Al. Ch.		1200
75	West.	SK-170	635
75	West. (2)	SK-180	475
75	Cr. Wh.	52-HM	480
60	West. (2)	S-160	680
50	West.	SK-133	1300
50	Diehl	K-10	850
50	West.	SK	750
50	West. (2)	SK-160	585
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC	1750
40	G.E.	RC-32	1100
40	G.E.	RC-13	1675
30	G.E. (2)	RC	1200
30	West. (2)		975
30	G.E. (2)	RC-33	775
30	West. (2)	SK-143	575
20	G.E. (2)	CD-83	1750
20	G.E. (2)	RC-11	1150
20	Star (2)	SR-316	29.2

115 V. D.C. Motors

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr. Wh.	CMC	900
25	G.E. (2)	CD	1800
25	Cr. Wh.	CCM	750
20	Century	BS	1750
20	G.E. (2)	CD-83	1750
20	West.	SK-110L	750
12½	G.E.	CDM-85	930/1160

600 V. GENERATORS

KW	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150
20	G.E.	1750

250 V. GENERATORS

KW	Make	Speed
1000	G.E.	900
500	West.	1100
330	Elliot	1200
300	G.E.	1200
300	Al. Ch.	1200
300	West.	900
300	West.	1200
200	G.E. MPC	1200
150	West.	900
150	West.	1180
150	G.E.	600
100	Hertner	1200
50	G.E.	1200
40	Reliance (4)	1750
30 (3)	G.E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. Generators

KW	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100 (2)	West.	900
100	G.E.	1200
100	El. Machry.	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	Sturt.	2800
40	Cent.	1450
30	Ideal (2)	1750
30	G.E.	1150
30	L.A.	1450
20	Delco	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

Low Voltage Generators

Amp.	Make	Voltage
8000	H-V-W.	6/12
1500	H-V-W.	6/12
1000	Col.	6/12
125	Hobart (8)	7½
3000	Chandeysson	12/24
300	Star	15
67	Cont.	15
750	Star	15
1000	G.E.	15
800	G.E.	22/23
600	Rel.	24
134	West.	24
175	Cr. Wh.	25
550	Col.	27
1600	G.E.	30
800	G.E.	30
100	G.E.	30
200	West.	30

Low Voltage Gen. (Cont.)

Amp.	Make	Voltage
205	G.E.	32
1000	G.E.	33
500	Chandeyssen (2)	40
1000	Chandeyssen (2)	40
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50

Transformers

4—333 KVA Maloney 2300/4600 Primary 220/440 Secondary

300 KVA—Al. Ch. 3 phase, 4160 V. primary, 230 V. secondary.

300 KVA—Pitasburgh, 3 phase 4160 V. primary, 230 V. secondary.

75 KVA—(3) G.E.-H-KF 2400/4160 Y-240/480 V.

New D.C. Starters

150—230 V. Magnetic 5 H.P. to 75, H.O. G.E., C-H, A-B, W.L. etc.

100—230 V. Manual and Compound 1 H.P. to 5 H.P.—$G.E. & C-H.

40—7½ H.P. 230 V. C-H—magnetic reversing.

A.C. Starters

1—475 H.P. West. Magnetic Reduced voltage, 550 V. syn.

4—400 H.O. C-H Bul. 9976 440 volt. Magnetic red. volt. synchronous.

1—250 H.P. C-H. 4150 V. synch. full voltage.

1—150/200 H.P. G.E.—440 V. CR-7065 synch.

3—150 H.P. GE 220V-CR 7061 synch.

New A.C. Starters

40—C-H & A-B 2 and 4 speed Magnetic up to 25 H.P.

20—50 H.P. C-H 440 V. Magnetic.

165—20 H.P. W.L. 440 V. Magnetic.

635—7½ H.P. C-H 440 V. Magnetic.

Air Compressors

425 Cfm. Sullivan 2 stage.
360 Cfm. American 125 lbs.

Electric and Air Hoists

17—2 ton Shepard-Niles, 230 V. D.C.
8—500 lbs. P. & H. Zip Lift, 3 phase.
1—2 ton Thor, pneumatic.
1—½ ton, Thor, pneumatic.

400 Cy. Gen.

1—3 KW G.E., 3 ph. 110 volt.
1—7½ KW G.E. 3ph. 400 cy.
1—10 KW G.E., 200/700 cycle.
1—15 KW G.E. 3ph. 400 cy.

EST. 1910 — L. J. LAND INC. — 40th YEAR

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NEW and USED

Our stock is large and includes almost anything wanted in Diesel Power

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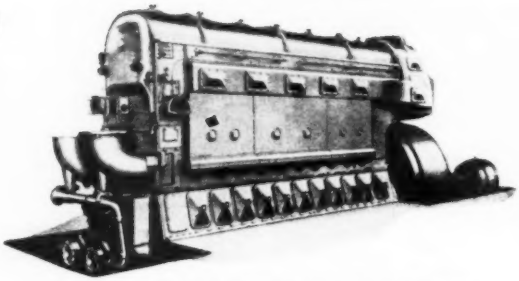

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They will save you many dollars

Also on Turbine-Generators and Boilers

Above Cut Shows Fairbanks-Morse Latest Model 38D8 1/8 Opposed Piston Diesel Engine, with New (never used) A.C. 3/60/2300/4160-v. Generator with Direct Connected Exciter, Etc.

SPECIALLY ADAPTED FOR MUNICIPAL AND ALL STATIONARY INSTALLATIONS: ASK FOR CITIES NOW USING THIS DESIGN

A FEW OTHER DIESEL POWER UNITS IN OUR STOCK:

6—Hamiltons, 1600-HP., 720-RPM., with West. Reversing Reduction Gears: SAME AS NEW: 15—Baldwin-Westinghouse 300-KW, DC., 240-v., 400-RPM.: 4—GM. Model 3-268-A, 100-KW. 4—FM. OP., 1200-HP., 720-RPM., Engines. 8-cyl. Nearly New. AND MANY OTHERS. Write Us. Giving Specifications.

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The following 3 transformers were used in one bank:
1—333 KVA, Gen. Elec 33000 x 13200/6600.
2—500 KVA, Pittsburgh 33000 x 13200/6600.

3—400 KVA, Westinghouse, 13200 x 240.
2—200 KVA, Packard 2300 x 115/230.
3—200 KVA, Westinghouse, 2300 x 230/460.
2—150 KVA, Gen. Elec. 2300 x 115/230.
3—150 KVA, Allis Chalmers 2400 x 120/240.
2—150 KVA, Pittsburgh 2300 x 230/460.
2—150 KVA, Pittsburgh 2300 x 115/230.
4—100 KVA, Gen. Elec. 2300 x 115/230.
Other sizes in stock in various voltages.

TURBO GENERATORS

1—500 KW, 3 ph., 60 cy., 440 V., to Gen. Elec. Turbine No. 39937. With condenser, switchboard, etc. Very modern unit.
1—500 KW, 3 ph., 60 cy., Gen. Elec. non-condensing.
1—750 KW, Gen. Elec. automatic extraction.
1—1000 KW, Gen. Elec. with surface condenser.
1—2000 KW, Gen. Elec. with surface condenser.

MOTOR GENERATORS

1—105 KW, 1500 amp., 70 V., to 150 HP, 3 ph., 220/440 volt, 1185 rpm, ball bearing Electric Products Co. Set.

MOTOR GENERATORS (Cont'd)

1—1000 amp., 80 Volt, Burke with 3 ph. syn. motor.
1—75 KW, 250 volt, 1200 rpm, 3 ph., 60 cy., 440 volt syn. motor. Star. Elec.
1—50 KW, 250 V., Louis Allis to 75 HP, 220/440 V., 1-K, G.E.
1—15 KW, 250 V., Westgh. SK to 3 ph., type CS motor.

CAPACITORS

8—180 KVA, Westgh. Interteen 3/60/460.
6—120 KVA, Westgh. Interteen 3/60/460.
11— 90 KVA, Westgh. Interteen 3/60/460.
3— 90 KVA, Gen. Elec. Pyranol 3/60/460.

MISCELLANEOUS

1—30 KW, .8 PF, Century to a Buda diesel, complete.
2—25 KVA, 1 ph., 60 cy., 120 or 240 V. Westgh. to 4 cylinder LeRoi engines with panels.
1—150 KW, 125 V. Cr. Wh. gen. to 4 cylinder vert. Ames st. engine
1—1000 HP, Gen. Motors Diesel engine to 600 KW, 500 volt, 750 rpm, Westgh. generator.

Send for our catalogue of A.C. & D.C. motors, A.C. & D.C. Generators, transformers, starters, and other related equipment.

KEYSTONE POWER PLANT EQUIPMENT COMPANY
8403 HEGERMAN ST., HOLMESBURG, PHILADELPHIA 36, PENNA.

COMPRESSORS—VACUUM PUMPS
NEW and GUARANTEED REBUILTS

SPECIALS

6½x6½x4 Worthington VA 104 CFM 80 Lbs.
75 HP Ingersoll motorcompressor 387 CFM 125 Lbs.
7/3 ⅛ x 7 Chicago T-CB 105 CFM 350 Lbs.
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Any Make—Any Size—We Can Help You, Portable or Stationary

American Air Compressor Corp.
Dell Ave. and 47th St., North Bergen, N. J.

600 KW DIRECT CURRENT GENERAL MOTORS DIESEL SET, Westinghouse Generator 500 Volt, 720 RPM. Electric Start. Unused.

450 HP ENTERPRISE DIESEL ENGINE, Model DSG-6, 6 cyl., 4 cycle. 450 RPM, air start, solid injection. Unused.

Other sizes in stock from 10 to 1000 KW.

ALJOHN DIESEL CO., INC.
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AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK

POWER PLANT EQUIPMENT

STEAM ENGINE GENERATOR SETS

2—575 KVA Skinner Unaflow—West. 240/480 V.
1—575 KVA Allis-Chalmers Corliss—220/440 V.
1—375 KVA Ames Vertical 220/440 V.
1—250 KVA Ridgeway four valve 2300 V.
1—187 KVA Ames Vertical 220/440 V.
1—156 KVA Ames Vertical 220/440 V.

STEAM TURBINE UNITS

Complete 2000 KW Turbo-Generator Plant:
1—1500 KW G.E. condensing—3600 RPM
1—500 KW G.E. condensing—3600 RPM
These units are of modern design, are 3 phase, 60 cycle, 2300 V.

DIESEL GENERATING UNITS

4 Diesel Generating Units, like new, comprising a complete diesel power plant, and consisting of two 450, one 300, and one 150 HP Fairbanks-Morse model 32-E engine-generator units. Engines are of all duplicate cylinder size, 2400/4160 V. 3 phase, 60 cycle. Late model Woodward governors, pumps, cooling tower, etc. Operated only a short time. Available for immediate delivery.

1—250 KVA—220/440 V. G.M. "twin"—NEW—not war surplus.

BEESON ENGINEERING CO.
1628 E. 7th St., Los Angeles 21, Cal.
MUtual 9151

MOTOR GENERATORS

1—300 KW GE Rotary Converter 3/60/440 (transformers available for 2300) 250/275 v. DC, 900 RPM; w/control.
1—300 KW— M-G set 3/60/440 (or 2300) 1200 RPM, 250/275 v. DC; NEW GE syn. drive.
1—100 KW M-G set 3/60/440 (or 2300) 1200 RPM, 250/275 v. DC, NEW Delco; G.E. syn. drive.
1—200 KW, 250 v. DC gen. 450 RPM, comp. wnd. Whse., 2 brg., slide base.
3—125 HP, 1200 RPM Elec. Mchy. 3/60/440, syn. motors, unity P.F., type BRKT.
1—300 HP, 485 RPM, A-C, slipring, 3/25/440 w/drum and grids.
1—175 HP, 710 RPM Wagner, cage, 3/25/440 type 31V5BP.
1—25 KVA Transformer 7200/12470Y—120/240 v. 1/60, Moloney KL, 2-HV bushings, like new.

C & S MACHINERY COMPANY
715 Howard Street, St. Louis 6, Mo.

50,000 lb. Integral Furnace 400 lb. B & W boiler superheater air heater pulverizer fans accessories
2500 KW 2400 volt GE Cond. turbine unit.
1500 KW 480 volt GE NonCond Turbine set.
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200 KVA 480 volt Ridgway 4 valve engine set.
200 KW G. E. M. G. Set 2200 AC 250 DC.
50 KW G. E. M. G. Set 220/440 AC 230 DC.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT — PARTIAL LISTING

VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

On.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-522
2	10	1140	440	West.	HF-7A
2	10	870	220	G.E.	HI-11
2	11†	820	550	G.E.	ITC-5008
2	15	1180	440	West.	CW-464C
2	15	870	220	West.	CW-646
1	18	880	440	West.	MW-316
1	20	880	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	885	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	875	440	G.E.	MT-336
2	35	600	440	F-M	HV-H16A
2	40	865	2200	Al-Ch.	ARY-223C
1	40	580	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	860	440	West.	HF-12A
1	50	570	440	G.E.	MT-552
5	52†	550	220	G.E.	IQC-5013***
1	60	885	440	West.	CW-758
1	60	850	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80†	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IT-16
2	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-F15A
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW-
1	600	1770	440	G.E.	IM-F15C
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
†Intermittent rating. ***2 Phase.
**New. ‡‡25 Cycle.

230 VOLT CONST. SPEED D. C. MOTORS

On.	H.P.	Speed	Make	Type
20	2	850	West.	SK-20
7	3**	1150	Al-Ch.	EB-71
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	B.A-5324
5	10**	1150	Al.-Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
1	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

On.	H.P.	Speed	Make	Type
10	1½/2	500/2000	G.E.	CD-65
1	2	225/900	Reliance	7ST
1	5	450/1800	G.E.	CD-83
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
2	10/15	600/2400	Reliance	T-92T
1	12½	280/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-230-T
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1200	Reliance	T-461T
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/800	West.	SK-220
2	375	350/500	G.E.	MPC

**New.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

On.	H.P.	RPM	Volts	Make	Type
2	¼	1750	220	R&M (TE)	T-184
1	⅓	1725	440	G.E.	K-63
4	1	1140	220	Howell	A-204
4	1.5	1150	220	L.A. (TE)	JS-225
5	1.5	1140	440	West.	CS-225
1	2	1735	220	G.E.	K-224
1	2	1100	220	West.	CS-225
2	3	1160	440	L.A.	JS-254
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-405S

Splashproof, Ball Bearing

On.	H.P.	RPM	Volts	Make	Type
1	2	1735	440	G.E.	K-224
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1172	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

On.	H.P.	Speed	Volts	Make	Type
5	2	170	440	G.E.	KT-926
4	2	1160	440	West.	CS-930
1	2	690	440	G.E.	KT-944
10	5	1740	440	West.	CS-232C
1	7½	3475	440	West.	CS
1	7½	1750	440	West.	CS-250C
3	7½	1165	440	G.E.	KT-952
2	7½	870	440	West.	CS-370C
5	10**	1760	440	L.A.	OGA-324
5	10**	1750	440	West.	CSP-324
3	10	1160	440	West.	CS-370C
1	10	865	440	G.E.	KT-502
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC-326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
1	20	1150	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25**	875	440	Master	PH-305
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
1	50**	1740	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
1	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-352
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	1-17-FR
1	200	580	550	G.E.	KT-5668
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts.
**New ***2 Phase.
‡‡ Reconnectable for 440 volts.

CRANE, MILL TYPE, 230 V. D.C. MOTORS

On.	H.P.	Speed	Make	Type
2(115V.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCS-20
2	9.5	750	G.E.	MDS-404AE
1 (new)	10	650	G.E.	MD-403-BE
1	23	600	G.E.	MDS-405AE2
3	25	500	Diehl	TE
2	27½	535	West.	K-7
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50	750	G.E.	CO-1829A
1 (new)	50	600	West.	CK-9
4	50	525	G.E.	CO-1830
1	59	470	G.E.	CO-2067
2 (new)	60	550	G.E.	COM-1831 AE

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO
4521 HAMILTON AVE. CLEVELAND 14, OHIO

POWER EQUIPMENT

PUMPS
Rotary Pumps Turbine Dr. • Centrifugal Pumps Turbine Dr. • Centrifugal Pumps Motor Dr. (Vert. & Horizontal) • Reciprocating Pumps Duplex (Vert. & Horizontal) • Reciprocating Pumps Simplex (Vert. & Horizontal)

NORTHERN METAL CO.

IMMEDIATE DELIVERY

NUMEROUS OTHER ITEMS AVAILABLE FOR INDUSTRIAL USE

FOR COMPLETE INFORMATION — WRITE — PHONE

DIESEL ENGINES

General Motors 900 HP Model 12-567, 2 cy. 12 cyl. 744 RPM with Falk reversing and reduction gear, ratio 2½ to 1. Electric starting. Auxiliaries available.

DIESEL GENERATORS

100 KW DC 240/120 V., 417 Amps. 1200 RPM Motor: Superior, 150 HP Model GDB-8 8 cyl., Electric starting.

TURBO-GENERATORS

132 KW. AC, GENERAL ELECTRIC, Generator: 450 & 220 V, 3 Phase, 60 cycle, 1200 RPM. 275 Amps. Exciter: 40 KW. DC. 120 V. 22.6 Amps. Reduction Gear: 10071 to 1200 RPM. Turbine: 172 KW. Condensers available.

60 KW. DC. WESTINGHOUSE, Generator: 120 V. 1800 RPM. 500 Amps. Reduction Gear: 7283 to 1800 RPM. Turbine: 60 KW. 89.4 H.P. Condenser available.

MILNOR & BLEIGH STS. • *Phone MAyfair 4-1400* • PHILA. 35, PA.

NEW MOTORS AND CONTROLS

AT REDUCED PRICES!

SLIP RING

220/440 VOLTS

Qu	HP	RPM	Mfg.	Shaft
1	100	720	Elliott	3½x 6
2	125	720	Elliott	4x12
1	150	720	Elliott	4x12
2	500	1200	Elliott	4½x 8

All sealed sleeve bearings on original skids.

New control available for each motor.

NEW SLIP RING CONTROLS

15—125 HP, 220 Volt.
15—250 HP, 440 Volt.

Fully magnetic, reversing and plugging with main line air circuit breaker.

Suitable for hoist, crane, dredge, mill duty.

Open Type.....$1150
Enclosed.....$1475

GEARHEAD

220/440 VOLTS

Qu	HP	RPM	Mfg.	Frame
3	¾	190	MST	204
4	1	155	STLG	203
4	1	230	STLG	204
3	1	350	STLG	204
1	2	45	STLG	225
1	2	100	U. S.	224
2	2	125	U. S.	254
3	3	45	STLG	284
1	3	290	WHS	225
2	3	350	WHS	225
2	5	25	WHS	284
4	5	34	WHS	254
4	5	125	U. S.	254
2	7½	25	U. S.	882
3	7½	34	WHS	254
1	7½	56	U. S.	877
1	10	20/60	STLG	324
1	Foote	18	60DX	10:1
1	Amer.	50	Navy	16:1

In original crates—with half coupling.

NEW SPEED REDUCERS

Qu	Mfg.	HP	Type	Ratio
6	Falk	5	28DU	10:1
2	Falk	10	32DU	10:1
1	Abart	15	6A	18:1

DIRECT CURRENT

230 VOLTS

Qu	HP	RPM	Mfg.	Frame
3	3	690/2660	G.E.	284
15	5	850/1700	G.E.	CD-66
5	7½	515/1750	G.E.	CD-77
4	7½	575/1750	Rel.	T-46
2	10	575/1750	G.E.	CD-85
3	10	1750/2200	Rel.	T-34
5	30	850/1700	Rel.	T-230
1	75	400/1200	Rel.	T-651
2	75	1750	F-M	1509

All ball bearing—drip proof.

PLANER MOTOR

50-100 HP, 600/1500 RPM
230 v. DC, RELIANCE
Drip proof, ball bearing
Double shaft extension
NEARLY NEW
PRICE.....$1850.00

THE BOSWICK ELECTRIC CO.

P.O. Box 1111 AKRON 9, OHIO WAlbridge 1195

Buy from BOSWICK with confidence

POWER PLANT MACHINERY

CONDENSING TURBO UNITS
3 phase 60 cycle

25000 KVA G.E., 13800 volts, 400# steam.
12500 KVA G.E., 2400 volts, 200# steam.
6000 KVA (2) G.E., 4000 volts, 600# steam.
2250 KVA G.E., 2300 volts, 400# steam.
1563 KVA G.E., 2300 volts, 225# steam.
1563 KVA Allis, 600 volts, 200# steam.
1560 KVA Allis, 240 volts, 180# steam, 5# extraction.
1250 KVA G.E., 4000 volts, 400# steam.
938 KVA G.E., 240 volts, 1250# steam.
937½ KVA Elliott, 480 volts, 400# steam, 50# extraction.
750 KVA G.E., 480 volts, 200# steam, 15# extraction.
625 KVA Westg., 480 volts, 275# steam, 10# extraction.

NONCONDENSING TURBO UNITS
3 phase 60 cycle

5000 KVA G.E., 13800/6900/4000 volts, 600# steam, 150# extraction, 50# exhaust.
1563 KVA G.E., 2400 volts, 250# steam, 20# exhaust.
937 KVA G.E., 480 volts, 200# steam, 20# exhaust.
625 KVA G.E., 240 volts, 175# steam, 5# exhaust.
375 KVA G.E., 240 volts, 150# steam, 10# exhaust.

BOILERS
A.S.M.E. Code

40,000# per hour Vogt, 450# steam, chain grate stoker.
40,000# per hour B & W, 200# steam, chain grate stoker.
650 H.P. (3) Badenhausen, 150# steam, oil & gas fired.
250 H.P. B & W Sterling, 175# steam, chain grate stoker.

UNIFLOW UNITS
3 phase 60 cycle

750 KVA Skinner, 2300 volts, 160# steam, 5# exhaust.
625 KVA Skinner, 240 volts, 150# steam, 5# exhaust.
500 KVA Skinner, 450 volts, 130-160# steam, 5# exhaust.
375 KVA Ames Vertical, 440 volts, 150# steam, 5# exhaust.
312 KVA Skinner, 480 volts, 115-140# steam, 5# exhaust.
250 KVA (2) Skinner, 450 volts, 160# steam, 5# exhaust.

MOTOR GENERATOR SETS
3 phase 60 cycle

500 KW G.E., 125/250 volts DC, 2300 volts AC, synchronous.
500 KW G.E., 550 volt DC, 2300 volts AC, synchronous.
200 KW G.E. 125/250 volts DC, 2300 volts AC, synchronous.
60 KW G.E., 125 volts DC, 440 volts AC, induction.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16B	Ball Bearing	750
75	Fairbanks Morse	H16C	B.B. Slipring	750
75	Gen. Elect.	IK	2200 volt	750
75	Gen. Elect.	IK		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
400	Gen. Elect.	IM 17A	Slip Ring	730
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

MOTOR GENERATOR SETS

2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP, 3 Phase 25 Cycle motors —Will rewind for 60 Cycle operation.

3000 CYCLE MOTOR GENERATOR SET

GENERATOR—175 KVA General Electric A.C. Generator, type A.S.C. form AL, single phase, 800 volts, 3000 cycle, 1800 RPM, serial #5513639.
GENERATOR EXCITER—1 KW, General Electric Generator, type EE, form EB, 125 volts, D.C., 1800 RPM 8 amps., serial #1758769.
MOTOR—300 HP General Electric synchronous motor, type TS, form EL, .8 P.F. 3 phase, 60 cycle, 440 volts, 1800 RPM, serial #5513638.
MOTOR EXCITER—3 KW, General Electric Generator, type EF, form EB, 125 volts, DC, 1800 RPM 24 amps. serial #1758730.
Motor and Generator are direct connected, 4 bearing. Mounted on factory fabricated base, with direct connected exciters.
3000 Cycle Control is mounted in cubicle also containing 300 HP General Electric synchronous motor starting control.

NEW MOTORS

300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

HORIZONTAL & DUPLEX Compressor & Vacuum Pumps after Coolers, Filters

60 CYCLE GENERATOR

1—45 KW Gen. Elec. Generator Type A.T.B. 8 PF. 3 phase 60 cycle 2300 volts 1200 RPM. Serial No. 4313990 with direct connected exciter and panel boards.

NEW TRANSFORMERS

3—25 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
3—37½ KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
6—50 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—75 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
3—150 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—200 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—250 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—333 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.

REBUILT TRANSFORMERS

Qu.	KVA	Make	Cycle	Voltage
3	50	Pitts.	25	11000/2300
2	50	Kuhlman	25	11500/2300/230/460
1	50	Kuhlman	25	11500/115/230
2	50	G. E.	60	2400/120/2400
1	100	G. E.	25	4600/230/460
3	400	Pitts.	25	12000/110

FREQUENCY CHANGERS

All Sizes in Stock. 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 cycle and any other high cycle.
1—180 cycle, 50 KW G.E. Type MM 3 phase, 220 volt direct connected to 50 HP G.E. motor Type K445S. 3/60/220-440/1800 RPM.

100 KVA TRANSFORMERS

3—100 KVA Gen. Elect. Transformers. Type H Form KF—2400/4160 volts primary 120/240 volts secondary. Price $450.00 each. Electrically O. K. F.O.B. truck, Minnesota.

SLIPRING MOTORS
3 Phase—60 Cycle—220/440 Volts

H.P.	Make	Type-Frame	Speed	Remarks
2— 20	LA1	KH	900	
20	G.E.	MT-303	1800	
30	Cr. Wh.		1800	
3— 35	West.	CW	585	
35	G.E.	MT-342	690	
35	West.	MW	680	
40	West.	CW-748A	690	
6— 40	G.E.	MT-336	1200	
40	G.E.	MT-523	1800	
50	G.E.	MT-526	1200	
50	G.E.	MT-527	1800	
2— 50	West.	CW	1800	
60	G.E.	MT-533	1800	
60	West.	CW-655C	1800	
100	West.	CW	435	3 bearing
2—100	G.E.	I form M	900	
2—100	G.E.	MT-347	1800	
125	G.E.	I form M	1200	
2—250	G.E.	I form M-16	900	
350	West.	CW	435	2200 volts
500	Al. Ch.	ANY-WR	514	2200 volts
600	G.E.	MT	490	25 cycle
This motor will rewind satisfactorily to				
700	G.E.	MT	720	

VARIABLE VOLTAGE PLATING GENERATOR SET

1—60 KW Hanson-VanWinkle generator, 1500 Amp. 3-40 volts with exciter, direct connected to 100 HP Synchronous motor, 8 PF 3/60/440/600 RPM.

3 PHASE 550 VOLTS 25 CYCLE MOTORS

Write for our stock list of approximately 500—3/25/550 Voltmotors

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

NEW and REBUILT ELECTRIC POWER EQUIPMENT

SQUIRREL CAGE MOTORS—3 Ph—60 Cy.

HP	SPEED	MAKE	TYPE
40	3600	GE	FTR-523
40	1800	GE	FT523Z
40	1200	West	CS643C
40	900	GE	KT342
40	720	GE	KT346
50	3600	Al. Ch	ARWWX
50	1800	GE	KT527
50	1200	GE	FTR536
50	900	GE	FTR542
50	720	GE	KT352
50	600	GE	KT552
50	600	Al. Ch.	
60	1200	WAG.	BR
60	900	West.	CS-646
75	1800	GE	1-E11
75	1200	Diehl	IS-178
75	900	GE	KT352S
75	900	GE	KT552
75	900	GE	I-K
75	720	GE	I-K
75	720	Burke	EM
75	600	GE	I-K
75	514	GE	I-K
100	3600	West.	CS-445
100	1800	GE	KTP-543
100	1800	Cr. Wh.	35R
100	720	West.	CS-856C
100	720	Al. Ch.	
150	1800	West.	CS
150	1200	Cent.	SCN-585W
275	1800	GE	KF559

SLIP RING MOTORS

HP	SPEED	MAKE	TYPE
2	600	GE	MT-952
10	1750	West.	CW-324
10	1750	L.A.	OGH-324
10	1200	GE	MTC-5952
10	720	Al. Ch.	ARY-405
10	600	West.	CI-405
15	1200	GE	MT-312
15	900	GE	MT-322
25	900	Al. Ch.	ARY
25	600	GE	MT-342
40	1200	GE	MTC-5522
50	850	GE	MT-542
50	720	GE	MT-552
60	900	GE	MT-546
60	600	GE	MTC-5546
100	1800	GE	I-M
125	600	GE	MT-562
150	1800	F.M.	HV-Z20C
150	600	Al. Ch.	ANY
300	600	GE	MTC-5566Z
450	500	West.	CW

SYNCHRONOUS MOTORS

HP	SPEED	MAKE	TYPE
35	1800	GE	TS-543
50	900	GE	TS-945
50	225	Elec.	Machy.
108	1200	GE	TS-954Y
145	1200	West.	
150	720	GE	TS-7641
300	720	GE	TS-974Y

SPECIAL
NEW WESTINGHOUSE MOTORS
50 cy. 1450 RPM
BB DRIPPROOF
Export Packed
5—1½ HP 190/380 V
5—2 HP " " "
50—3 HP " " "
25—5 HP 380 V only

AC GENERATORS

KVA	MAKE	TYPE	SPEED
75	El. Machy.		900
160	GE		1200
219	GE	ATI-6304D	257
200	West.		600
300	GE	ATI-975Y	900

SPECIAL
Gasoline and Diesel Engine Generator Sets From 1 KW to 100 KW. AC and DC.

AC TO DC GENERATORS

KW	MAKE	AC	DC
400	Ideal	2300	250
100	GE	2300	250
75	Cr. Wh.	440	125
60	GE	220/440	250
60	GE	220	125

SPECIAL TRANSFORMERS
Write for complete list, recently purhased and available at ridiculously low prices.

230 V. DC MOTORS

HP	MAKE	TYPE	SPEED
150	Cr. Wh.	83H	900
150	GE	CDP-125	1750
125	Al. Ch.		600
112	Cr. Wh.	HHL	1750
100	GE	CDM	1200
100	Elec. Dyn.	108M	1800
90	West.	SK	575
50	West.	CK-9	600
50	Burke	WAGS	1450

SPECIAL
OUR NEW CATALOG #49 listing thousands of items is now available—WRITE—.

EMPIRE ELECTRIC COMPANY INC.

91 JAY STREET PHONE MAIN 4-6868 BROOKLYN 1, NEW YORK

FOR SALE

4000 KW TURBINE GENERATING PLANT

Consisting of

1—2000 KW and 2—1000 KW General Electric, 3 phase, 60 cycle, 480 Volts, 3600 R.P.M. Condensing Turbo Generator Units. Complete with all Auxiliaries. General Electric inspection reports are available.

A. G. SCHOONMAKER CO., INC.
52 CHURCH ST. Digby 9-4350 NEW YORK 7, N. Y.

FOR IMMEDIATE DELIVERY

1500 KW TURBO GENERATOR

1—General Electric Turbo Generator 1850 KVA, 80% P.F., 440 volts, 60 cycle, 3 phase, 225# pressure, complete with Worthington Condenser and Pumps, Air Ejector, Air Cooler, and Switchboard.

Complete Specifications Upon Request

Heat and Power Co., inc.
70 PINE STREET DIGBY 8-0373 NEW YORK 5, N. Y.

SURPLUS ELECTRICAL EQUIPMENT

2—2100 HP, GE Synchronous motors, 514 RPM, 4600/2300 V, 3 phase, 60 cycle, 80% P.F. Complete with rheostats and belted exciters. Full details on application.
2—2000 KVA Transformers—Single phase 60 cycle 69/34.5 KV to 4800/2400 V. Westinghouse O.I.S.C.
1—3500 KVA—3 phase, 60 cycle, 33/13.8 KV Westinghouse Transformer.
1—600 A., 3 P.S.T., 34.5 KV Outdoor O.C.B. Westinghouse CO-1-A.
1—3 pole, 600 A. 34.5 KV Outdoor Disconnect Switch.
Miscellaneous Distribution Transformers, Cable, Switches, Potheads and Electrical Instruments. Also Ross Carrier—hardly used. Arch measurements—91" high and 76" wide. 7 Ton capacity.

All the above are for immediate sale and are located at our Pulp Mill an Vancouver Island.

BLOEDEL, STEWART & WELCH, LTD
904 Standard Building, Vancouver, B. C.

FOR SALE

600 HP 350# ASME WT Boiler
6'x60', 4'x20', 3'x32' Rotary Dryers
750 & 100 KW Motor Generator Sets
308 HP (2) 200# ASME WT Boilers
2000 CFM Syn Motor Air Compressor
100 HP 2200/3/60/900 RPM Syn. Motor

H. & P. MACHINERY CO.
6719 Etzel Ave. St. Louis 14, Mo.

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Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment

POWERITE CORPORATION
140 Cedar St. New York 6, N. Y.
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ELECTRICAL CABLE

- for every industrial and power application
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

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CENTRIFUGAL PUMPS

Split Case Double Suction
Cast Iron Bronze Fitted
with or without motors

2—6" x 5" Allis-Chalmers all bronze 1000 GPM, 200' hd. 100 HP, 1800 RPM motor.

1—5" x 4" Gould 4 stage, 500 GPM, 1320' hd. 250 HP, 3500 RPM.

Large stock at all times of New & Used Rebuilt Pumps. Centrifugal—Rotary—Reciprocating.

DUPLEX STEAM DRIVEN AIR COMPRESSOR

Worthington Laidlow, 12½/23 x 22/13 x 16 Duplex—2 stage, serial #L26589, 1500. CFM DISPLACEMENT. JUST TAKEN FROM SERVICE

We Solicit Your Inquiries

C & S MACHINERY COMPANY
715 Howard Street St. Louis 6, Mo.

FOR SALE

IMMEDIATE DELIVERIES
REASONABLE PRICES

AC DIESEL GENERATORS

Several 1000 KW, 2300V, Fairbanks Morse, O.P., 720 RPM w/New Elliott or Crocker Wheeler Generators.
Several 600 KW, 2300V, G.M.C., 12 cyl., 720 RPM, w/New Crocker Wheeler Generators.
1—500 KW, 2300/480V, G.M.C., 12 cyl., 720 RPM, w/G.E. Generator.
Several 400 KW, 2300/480V, Baldwin, 6 cyl., 450 RPM, w/New EMCO Generators.
1—300 KW, 240/480V, G.M.C. 8 cyl., 1200 RPM.

DC DIESEL GENERATORS

1—610 KW, Cooper Bessemer, 8 cyl., 950 HP, w/G.E. 500V, 750 RPM Generator.
10—300 KW, Baldwin Westinghouse, 120/240V, 3 wire, 448 HP, 400 RPM. Like New.
2—300 KW, G.M.C., 8-268A, 120/240 volt, 3 wire, 1200 RPM.
Several 100 KW, GMC, 3-268A, w/Allis Chalmers, 120/240V, 3 wire Generators.
Several 100 KW, Superior, 8 cyl. w/Delco, 120/240V, 3 wire Generators.

Subject Prior Sale

SUNDFELT EQUIPMENT CO., INC.
220 Hudson Street, Seattle 8, Wash.
Lander 9311

DIESEL GENERATOR SET!

225 HP Busch Sulzer Model DF, 3 cyl., 4 cycle, solid injection, 360 RPM. Direct connected 150 KW 3/60/2300 volt generator with direct connected exciter, air filter, muffler, etc. A modern unit in perfect condition only $4000 f.o.b. St. Louis.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

BOILERS

10 to 1000 H.P.
NEW-USED RECONDITIONED
Steam, Gas and Electric Power Equipment
J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

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ELECTRICAL POWER EQUIPMENT

A PARTIAL LISTING OF OUR TREMENDOUS STOCK OF QUALITY GUARANTEED

REBUILT MOTORS

IF YOU DON'T FIND WHAT YOU WANT LISTED WIRE, WRITE OR PHONE—WE CAN SUPPLY IT!

CHICAGO ELECTRIC

Carries a complete stock of rebuilt equipment of the following types:

- Squirrel Cage Motors
- Synchronous Motors
- Slipring Motors
- AC and DC Generators
- DIESEL and Steam Generators
- Transformers
- Switchboards
- Controls
- Hoists and Cranes
- Compressors

REBUILDING SERVICE

Prompt guaranteed engineering work on your electrical power equipment by our staff of experienced engineers. Write today.

SPECIAL

Complete-Modern-Like New 800 K.W. TURBO GENERATING PLANT

250 lbs. pressure—3/60/2300 volt Complete with Turbines, boilers, stokers, pumps and all auxiliaries.

Still in operation—inspection invited.

Can be purchased at a fraction of new replacement cost.

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Volts	Speed
700	G.E.	K	2200	1800
500	G.E.	K	440	3600
500	G.E.	KTP	440	1800
400	Al. Ch.	Spl. pf.	2300	900
400	Westg.	C.S.	2200	1800
350	Westg.	C.S.	2200	900
300	G.E.	I.K.	440	900
250	G.E.	I.K.	2200	900
250	Westg.	C.S.	2200	1800
200	G.E.	K.	2300	720
200	G.E.	K.F.	2200	705
200	Westg.	C.S.	440	720
150	G.E.	K.T.	2300	600
150	Cont.	TEFC	440	900
125	Westg.	C.S.	440	3600
125	G.E.	TEFC	440	1200
100	Al. Ch.	A.R.	440	514
100	Al. Ch.	A.R.	440	900
100	U.S.	Vert.	440	1200
100	Burke	E.M.	440	1200
75	Triumph	T.E.	2200	514
75	G.E.	F.T.	440	720
75	Westg.	Vert.	2200/440	900
75	G.E.	K.	220/440	1200
75	Al. Ch.	A.N.	440	1200
60	Al. Ch.	A.R.	440	514
60	G.E.	K.	440	1800
60	G.E.	TEFC	440	1800
50	Westg.	C.S.	440	900
50	G.E.	KT-348	440	900

SYNCHRONOUS MOTORS

1500	G.E.	ATI	4150	514
1000	Westg.		2300	900
710	G.E.	ATI	6600	720
700	G.E.	ATI	2300	720
600	G.E.	TRC	2300	450
450	E.M.		440	240
400	Westg.		2300	900
400	Westg.		2300	200
350	G.E.		2300	200
350	G.E.	TRB	2300	450

SLIPRING MOTORS

H.P.	Make	Type	Volts	Speed
3000	G.E.	I.M.	2200	120
1500	Westg.	H.F.	2300	233
1500	G.E.	M.T.	6800	253
1000	Al. Ch.	ANY	2300	240
800	Westg.	C.W.	6600/440	507
750	Westg.	C.W.	2300	900
750	G.E.	M.T.-16	2300	450
600	G.E.	I.M.	2300	600
600	G.E.	I.M.	440	352
500	Ideal	A.V.	2200/4000	1800
500	Al. Ch.	ANY	2300	514
400	G.M.	I.M.	2300	900
400	Al. Ch.	ANY	4000	1180
400	Al. Ch.	ANY	4000	514
350	G.E.	I.P.	2300	720
350	Westg.	C.W.	2300	450

MOTOR GENERATOR SETS

1000 KW generator, General Electric, type MPC, comp. int. 275 volt, 514 RPM, direct connected to 1120 KVA synchronous motor, General Electric, type TS, 3 Ph., 60 cy., 4600 volt, 514 RPM, on fabricated steel sub-base. All complete.

500 KW MOTOR GENERATOR SET

500 KW DC generator, General Electric type MPC, comp, int. 250 volts, 720 RPM. direct-connected on fac. base to 710 HP synchronous motor, General Electric, type ATI, 3 phase, 60 cycle, 440/2300 volts. All complete.

2 COMPLETE VARIABLE VOLTAGE DRIVES

M. G. SET. 290 KW DC generator, General Electric, type MPC, 250 volts, 800 amps, 1200 RPM, direct connected to 300 HP synchronous motor, General Electric, type TS, 3 ph., 60 cy., 440 volt, 8 P. F. 1200 RPM.

D.C. Motor 250 HP General Electric, type MPC, form A, 245 volts, 730/975 RPM. With complete Starting and Control Panels.

CHICAGO *Electric Co.*

1320 W. CERMAK ROAD CHICAGO 8, ILL.
PHONE: CAnal 6-2900

TRANSFORMERS

FOR SALE

2—150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6—100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. Philadelphia 20, Pa.

Quality SINCE 1906

Wente Motors

WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT . . . BY EXPERTS

SQUIRREL CAGE
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	Al. Ch.	I (2200 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT	1800
4	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	100	G.E.	I-16	450
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	FT	3600
2	125	Cr. Wh.	126Q	450
8	125	Al. Ch.	AR	450
2	150	Al. Ch.		1750
1	250	G.E.	I-17	900
1	250	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

50	Al. Ch.		520
50	Al. Ch.		720
50	Ideal	AV	600
50	G.E.	I	700
60	Ideal	AVX	1200
75	West.	CW	400
75	G.E.	I	520
75	Fair. Morse	BV (2200 V.)	1800
100	G.E.	TRB	600
100	G.E.	I-16 (2200 V.)	450
100	West.	CW (8. P.)	1800

Qu.	HP	Make	Type	Speed
1	100	KW G.E.	ATB (8 PF)	900
1	125	Fair. Morse	T (2400 V.I.O PF)	900
1	150	G.E.	TS (8 PF)	1800
1	200	G.E.	TRC (8 PF)	400

D.C.—230 Volt
(Other voltage as noted)

1	50	West.	SK	850
1	50	G.E.	CD 1341	500/2000
3	50	Reliance	T	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	709
1	90	Cr. Wh.	CMC	225/550
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	130	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
3— 75 KW El. Mach. 1200 RPM — 230 V DC—440 V AC
2— 75 KW El. Prod. 1200 RPM — 220 V DC—440 V AC
1—100 KW Ridge. 1200 RPM — 250/275 V DC—440 V AC
1—105 KW Century 1200 RPM — 70 V DC—440 V AC
1—150 KW G.E. 900 RPM — 250/275 V DC—440 V AC

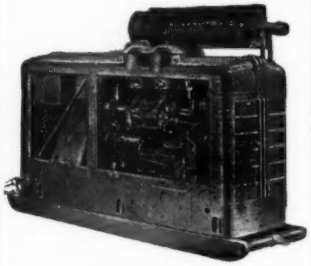
ALSO—*4000 motors other than listed from 1 HP to 900 HP*

Wente SINCE 1906 — *The Wente Electric Co.,* *Hamilton* 203 NO. FOURTH ST. Phone 4-8128 *Ohio*

NEW

60 KW GMC DIESEL SETS

FOR IMMEDIATE DELIVERY



These fully-portable, self-contained units are offered at considerably less than manufacturer's list prices.

WRITE OR WIRE TODAY
FOR COMPLETE INFORMATION

OTHER NEW UNITS AVAILABLE
FROM 10 KW TO 50 KW

A. G. SCHOONMAKER CO., INC.
52 Church St., New York 7, N. Y.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

BOILER UNITS

1—140,000# New Steam Generator 600#
1—140,000# MODERN Steam Generator 450#
2—60,000# MODERN Boilers 450#
2—40,000# MODERN Boilers 250#
2—30,000# MODERN Steam Generators 450#
2—1040 HP Heine Boilers—Super 200#
3— 750 HP Stirling Type Boilers 200#
1— 400 HP B&W Co. Sectional—Super 200 to 350#
2— 350 HP Straight Tube 200# Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—20,000 KW Turbo-Generator—Cond.
1—10,000 KW Turbo-Generator—Cond.
1—7,500 KW Turbo-Generator—Cond.
1—5,000 KW Turbo-Generator—Cond.
2—2,500 KW same as above
3—2,000 KW same as above } Also 400 & 600# Turbos
2—1,500 KW same as above
2—1,250 KW same as above
2—1,000 KW same as above
1—500 KW same—Also 750 KW & 300 KW Units
Non-Cond:—300 - 500 - 750 - 1000 - 1500 - 2000

COMPLETE STEAM PLANTS: One with 2-1500 KVA's, One of 2500 KVA & One of 7500 KVA.
Frequency Changers—Transformers! Send us your requirements—We may have it.
Send us your INQUIRIES *for* ALL POWER MACHINERY

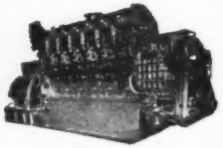
CHARLES B. REARICK — **30 CHURCH ST.** — **NEW YORK 7, N. Y.**

FOR SALE — DIESELS

1—300 KW Fairbanks-Morse Generator Set
1—300 KW Buckeye Diesel Generator Set
1—200 KW Buckeye Diesel Generator Set
1—175 KW Buckeye Diesel Generator Set
1—100 KW Buckeye Diesel Generator Set
2— 75 KW Buckeye Diesel Generator Sets
1—167 KW Fairbanks-Morse Generator Set
1—108 KW Fairbanks-Morse Generator Set

Many other units for belt drive.
Write for latest listing.

ROBERT L. NEISWANDER
Phone 4-2867
Cable Address: OHIODIESEL
LIMA, OHIO



DIESEL Generator Plants

1000 KW TO 100 KW
For Immediate Delivery

HEMCO

1000 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors and Fairbanks-Morse.
750 KW, 2400 Volts, 3 Phase. 60 Cycle, 720 RPM, General Motors.
300 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors.
100 KW, AC or DC, 1200 RPM, General Motors.
900 HP, General Motors, Propulsion Unit Complete.
General Motors Quads, Twins, and Singles.
Fairbanks-Morse O. P. Model 38D8 1/8 Diesel.

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

Tel. NEvada 6-2808
Cable Address HEMCOY

1412 So. Alameda Street
Compton, Calif.

USED EQUIPMENT FOR SALE

1—5 H.P. Spencer Vacuum Pump 40 Cycle
1—7½ H.P. Spencer Vacuum Pump 40 Cycle
1—Frequency Changer Set. 1400 H.P. Motor, 13,200 Volts, 60 Cycle. 1000 K.W. Generator 600 Volts 40 Cycle. Complete with switches and meter. Exciter Included.
1—Locomotive Crane—Brown—Capacity 18,000#
80—40 Cycle Motors—¾ H.P. to 175 H.P. 550 Volts 3 Phase
4—Fractional H.P. Single Phase Motors 40 Cycle 110 Volts
1—Duplex Two Stage Sullivan Compressor. 18 & 11x14 80# P.S.I. Class W.I. Complete with 100 H.P. 40 Cycle Motor.
1—Single Stage Ingersoll-Rand Compressor Class ER-1 20x12 30# P.S.I. Complete with 100 H.P. 40 Cycle Motor
1—300 Amp. 40 Cycle Welding Set
200—Hanna Air Cylinders

All of the above equipment is located in Ludlow, Massachusetts, and is available immediately as-is where-is subject to prior sale.

FS-8885, POWER
330 W. 42nd St., New York 18, N. Y.

SEARCHLIGHT SECTION

SLIP RING MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
300	2300/550	G.E.	900
250	2300/440	Whse.	600
200	440/220	Whse.	514
200	440/220	Whse.	900
200	2200/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse. (2)	1800
150	2200/440	G.E.	1200
150	440/220	G.E.	720
100	440/220	G.E.	600
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
240	440/220	Whse.	G	1800
200	440/220	G.E.	TS	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse	GE	600

GENERATOR SETS

1—62½ kva, 1200 rpm, 220 volt, Whse., geared to 7300 rpm, Whse., non-cond. steam turbine, 150 lbs. pr
2—unused 25 kva, 120/208 v., 3 ph., 1200 rpm, generator dir. conn. to Waukesha 6 cyl. gas engine

AIR COMPRESSOR UNIT

1—13" and 9" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. gs. motor-driven.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 800 v., air
2—1600 amp., ITE, 3 pole, 800 v., air
2—1200 ampere, Whse, 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
300	2200/550	Whse	CS	1800
250	2200/440	L. Allis	OGS	1200
200	440	G.E.	IK	514
200	440/220	Whse	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G. E.	IK	514
125	440/220(2)	G. E.	IK	514
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	2200/440	G.E.	K	1200
60	440/220 (new)	L. Allis	OGA	1800

A. C. GENERATORS

1—320 kva., 600 rp m., 440/220 v., G E.
1—250 kva, 720 rpm , 2300/440v., G.E.
1—250 kva, 600 rpm., 2200/440 v., G.E.
1—225 kva., 600 rpm , 220/440 v., G.E.
210 kva, 1800 rpm, 440/220 volt, Westinghouse
100 kva, 1200 rpm, 440/220 volt, Westinghouse
1—112 kva , 900 rpm., 440/220 v., G.E.
2—75 kva., 1800 rpm , 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2)	G. E.	CD	1150
200	230	Cr. Wh.	CMC	890
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	645
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

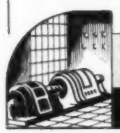
MOTOR GENERATOR SETS

1—165 kw, 6 ph., 1200 rpm , 250/125 v., G. E. rotory converter complete tr2nsformers, etc.
1—105 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm. 440/220 v., squirrel cage
1—150 kw, 900 rpm, 240 v., Cr. Wh., conn. to 225 hp, 900 rpm, 2200/550 v., squirrel cage.
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous
1—75 kw., 125 v., 1200 rpm , G.E. conn. to 120 hp., 1200/440 v., syn. motor.
1—50 kw., 250 1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., G.E. syn. motor.

TRANSFORMERS

60 Cy.

1—1000 kva., Al. Chal. 2400-120/240/208 volts, 3 ph.
3—500 kva, Al. Chal. 2400-480 v.
1—400 kva., G.E. 2300-230/115
3—250 kva, G.E., 2400—240/480 volts
3—250 kva, G.E., 13800—230/460 volts
3—200 kva, Moloney, 4150/7200Y—120/240 volts
2—150 kva., G.E., 13800/6000-110/220 v.
1—150 kva., Whse. SK, 13200-125/215 v., 3 ph
3—150 kva., G. E., 2300—230/460 volts
3—100 kva, G. E., 13800—230/115 v. NEW
6—100 kva., G.E., 4600/2300-230/115. NEW.
3—100 kva., G.E., 450-115/230 v., dry, 1 ph., new
5—75 kva., G.E., 2400-240/120 v.
3—75 kva., G.E., H-KF, 2300-230/460 v.



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HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

NEW MOTORS
IMMEDIATE SHIPMENT
30% DISCOUNT
G.E., WEST., ALLIS CHALMERS, RELIANCE, CENTURY, ETC.
From 1 HP to 300 HP
1, 2, & 3 Phase
All Speeds All Voltages
Open, Drip Proof
Splash Proof, T.E.F.C., Exp. Pr.
Large stock of rebuilt transformers, motor generators, etc. Write, Wire or Phone.
ELECTRIC EQUIPMENT COMPANY
Rochester, N. Y.—Phone Glenwood 6783

FOR SALE
MODERN 1000 KW Turbo-Generator
in Excellent Condition
Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.
NEWMAN & COMPANY, INC.
739 Drexel Building Philadelphia, Pa.

FOR SALE
GEAR TRANSMISSION
300 HP Sturtevant
2515 to 900 RPM Design #3
ELECTRIC APPARATUS REPAIR CO.
1400 No. 6th St., Phila. 22, Pa.

For Sale
Generator Voltage Regulators
General Electric GDA, Westinghouse Silvertat, Allis-Chalmers Rocking Contact. For AC and DC Generators All Sizes Available for Quick Delivery.
Western Regulator Exchange
1730 Wazee St. Denver, Colorado

TURBO GENERATORS

TURBINE OF THE MONTH
1—4000 K.W. General Electric AUTOMATIC EXTRACTION 250 lbs. I.S.P., 150° F.S.H., 3" abs., 15 lbs. G. extraction 3600 RPM, Surface Condenser, Generator 3 phase, 60 cycle, 2400 volts, Turbine Serial No. 37,000 Series.

1—2000 KW G.E. 6600v, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter. Factory Rebuilt.
1—1000 KW Westg. 400±, 700 F, condensing 3 ph, 60 cy. 2400 V. Surface condenser.
1—1000 KW G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine. Surface condenser.
1—750 K.W. G.E. 250/275 lbs. I.S.P. condensing Type FN3, Serial No. 61707, 3/60/440 volts 1944 unit.
1—450 K.W. Westg. 250/275 lbs. cond., 3 ph., 60 cy., 440 v. dir. conn. exciter, surface condenser.
1—300 K.W. G.E. 150/175 lbs. I.S.P., 5/15 lbs. G.B.P. non-cond., 3 ph., 60 cy., 480 v. dir. conn. exciter.

SPECIAL OFFERING
1 Set—36 New Factory Armature Coils. For 1250 KW G.E. Generator Rigid Frame. Type ATB2—3600 RPM, 3 phase, 60 cycle, 480 volts.

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Also N. Y. CITY LINE—RECTOR 2-7150

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KAELBER Since 1920 FIRE BRICK CONSTRUCTION
BOILER BRICKWORK
BOILER ERECTION
NEW YORK TO CALIFORNIA
Refractory Linings For Gas Generators, Rotary Kilns, Incinerators, Furnaces
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Most all units still on foundation. Many may be seen operating

TURBO UNITS (Cond.)
1625 KVA Wghse. 3-60-2300 v. Bleeder
1250 KVA GE 3-60-440 v.—Bleeder
1250 KVA (2) Elliott 480/240 v.
1250 KVA (2) General Electric 2300/4150 v.
1250 KVA (2) General Electric 480 v. (bleeder)
750 KVA General Electric 2300 v.
750 KVA General Electric 220/480 v.
625 KVA General Electric 2300 v.
375 KVA General Electric 2300 v.

TURBO UNITS (Non-Cond.)
625 KVA GE 480/240 v., 30/50# BP
625 KVA General Electric 2300 v.
375 KVA (2) GE 2300/440/220 v.
250 KVA General Electric 600 v.
62½ KVA, 112 KVA, 125 KVA, 200 KVA and 250 KVA GE 480/220 v. units.

DIESEL UNITS
375 KVA FM 480/240 v. (Model 32E-14)
156 KVA Ideal 240/480 v.—Buckeye
125 KVA GE 240/480 v.—Superior
93 KVA GE 480/240 v.—Superior
75 KVA GE 240/480 v.—General Motors
50 KVA FM 240/480 v.—Model 36-A
37 KVA (3) General Motors 240/480 v. (NEW)
Gas Unit—375 KVA GE 480 v.—Cooper Bessemer Gas

BOILERS
623 HP Vogt 4 drum 450#, Chain Grate Stoker
605 HP Union 3 drum 200#
507 HP Combustion 400#
488 HP Heine 250#
400 HP (2) Casey Hedges box header, 200#, Completely overhauled
255 HP B&W 3 drum 200#
200 HP Erie City 3 drum 160#
110 HP Erie City 3 drum 180#
280 HP Combustion HRT 150#
106 HP Ames "Economic" 125#
214 HP Kewanee Loco. type 125#

STEAM ENGINE SETS, A.C.
1125 KVA GE-Nordberg Uniflow
500 KVA GE-Skinner Uniflow
315 KVA Wghse.-Ames Uniflow
312 KVA (2) CW-Skinner Uniflow
312 KVA GE-Chuse 4 valve
312 KVA GE-Ames Uniflow
250 KVA (2) GE-Skinner Uniflow
187 KVA CW-Skinner Uniflow
187 KVA Wghse.-Ames Unif. (vertical)
187 KVA GE-Chuse 4 valve

PUMPS — MOTOR DRIVEN

COMPRESSORS — MOTOR DRIVEN

TRANSFORMERS

MOTOR GENERATOR SETS

POWER PLANT EQUIPMENT CO., INC.
39 Cortlandt St.
New York, N. Y.

FOR SALE BY CITY OF LEBANON, MISSOURI

1—400 H.P. Erie City Boiler 200# P.S.I. ASME—with Fryr Spreader Stoker and Forced Draft Fan—in service—1937—18,000# capacity—excellent condition—on foundation bid desired for late summer removal.

1—225# Worthington Feather Valve Air Compressor—410 cfm—13/7 x 12 stroke driven by 100 H.P. 2300 volt, 3 phase, 60 cycle synchronous motor—complete with exciter, switch and tank—Available immediately, f.o.b. Lebanon cars.

1—Six panel Westinghouse Switch gear (600-400-200-200-150-100 amps) 2400 volt, 60 cycle completely equipped—Available July or August.

B. W. JOHNSON, *City Manager*

AC GENERATOR

750 to 850 K.V.A., 480 V., 60 C., 3 P., 300 to 600 R.P.M., 3 bearings, belt driven, complete with exciter and control panel.

Will consider synchronous motor conforming to above specifications.

Will pay reasonable price, subject to our inspection before delivery.

E. L. BRUCE CO.
Box 397 Memphis, Tenn.
Attention: Chief Engineer, Mr. C. DEMERE.

SPECIAL TRANSFORMERS—YOUR SPECIFICATIONS

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OIL COOLED
AIR COOLED
PHASE CHANGERS

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0488

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

FOR SALE

1—General Electric Type CR-7160-G2B, new metal enclosed, reduced voltage starter, 4160 volt, suitable for 200 HP synchronous motor, complete.

THE FORAM MANAGEMENT CORP.
76 Beaver St., New York 5, N. Y.

BOILER

Union Iron Works, 535 h.p. horizontal tubular Boiler, 3 drum, A.S.M.E. Code, 199# steam pressure, complete with the following: Superheater, boiler meter, soot blowers, electric eye, coal pulverizer, steel coal bin and bucket conveyor, new 1930, condition good. *Sacrifice for quick sale.*

SURPLUS & SALVAGE CO., INC. JAMESTOWN, N. Y.

FOR SALE

Ames uniflow 16x16 with General Electric A.C. generator. Type ATB, form B, 120 KW, 240 volts. Complete with panel and exciter.

UNIT SYSTEM LAUNDRY
866 DeKALB AVE., BROOKLYN, NEW YORK

STEEL STORAGE TANKS

2—1000 & 2—10,000 Bbl. New Vertical
6—74,000 & 35,000 Bbl. Vertical
8—25,000 Gal. Cap. Horizontal
50—10,000 & 3—20,000 Gal. Horizontal

STANHOPE, Rosemont, Penna.

BOILERS

3—300 h.p., B&W National Board 200 lbs. pressure, straight tube.
1—100 h.p., LUCY loco. 250 lbs. pressure, with burner and stack. Installed 1946.

M. J. HUNT SONS
1600 N. Delaware Ave., Phila. 25, Pa.

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Anything you want

that other readers of this paper can supply

OR—

Something you don't want

that other readers can use, advertise it in the

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For Sale

BROS
WATERTUBE BOILERS
IMMEDIATE DELIVERY
1—25,000# 1—15,000#
for SPREADER STOKER or OIL FIRING

Automatic Combustion Eqpt. Co., Inc.
P.O. Box 1478, Rochester, New York

Sacrifice—One Diesel Generator

100 KW DC 120 240V, 417 Amps. 1200 RPM Motor: Superior, 150 HP Model GDB-8, 8 cyl. Electric Starting. Includes Switchboard.
Good condition. Must vacate warehouse. Best offer.

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12 CAN GROUP
Two 45 ton tanks with 300 lb. cans with all handling equipment *for immediate delivery.* Complete plant only.

DASCO
1307 St. Clair Ave., Cleveland 14, Ohio
Phone MAin 6729

IMMEDIATE SHIPMENT!

2—150 H.P. Cyclotherm Steam Generators, 150 psi, new, designed to fire #3 fuel oil, complete with return systems and auxiliaries, and many extras. Bargain for quick sale.

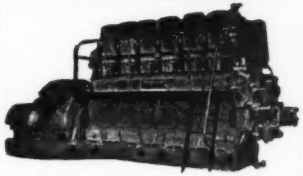
WIRE WRITE PHONE

SEE Fletcher FIRST!

FLETCHER SALES CO.

325 Fincastle Building LOUISVILLE, KY.

ENTERPRISE DIESELS



Quan.	H.P.	Model	R.P.M.	K.W	
*2	450	Enterprise DSG-6	450	300	AC
*2	450	Enterprise DSG-6	450	300	DC
2	1600	General Motors 16-278-A	720	1000	AC
2	450	General Motors 8-268-A	1200	200	AC
*2	240	Buckeye 60	600	160	AC
2	150	General Motors 3-268-A	1200	100	DC
2	150	General Motors 3-268-A	1200	100	AC
*2	90	General Motors 6-71	1200	60	AC
*2	90	General Motors 6-71	1200	60	DC

*New.

DIESEL MOTORS CORP.
PORT WASHINGTON, N. Y.
Port Washington 7-2000

850C. F. M. DUPLEX AIR COMPRESSOR

12"x14", 100 P.S.I., Center Drive Flywheel, Lubricator, Unloaders

2000 GPM 150 PSI 8" Cent. Pump with 240 HP Steam Turbine
7—Diesel dr. br. Cent. Fire Pumps
1—6000 GPM 16" Centrifugal Pump.
3—750 and 1000 GPM Knowles Steam Pumps & other sizes.
1—14" Roots Blower & other sizes.
21—Air Compressors, various cap.
2—375 CFM Worthington 12" x 9" horizontal Vac. & Press Pumps.
5—2000-5000 GPM 32'-65' hd. 10" & 12" Kingsford Cent. Pumps.
11—Nash Vac. & Cond. Return Units.
375—Rebuilt Elec. Motors 1-200 H.P.
4—Kinney unused, 6" Rotary Pumps.
98—Exhaust Blowers & Fans.
17—Triplex Pumps, various sizes.
9—Nash ½ 0, 0, 1, 2 wet vac. pumps.
3—Blackmer Rot. 6" pumps 500 gpm.
1—Norwalk 4-stage Compressor 28 CFM, 5000 PSI, 20 H.P. Motor.
1—GE Turbo Blower 2-st. 3000 cfm, 16 psi. Also 1-st. 3000 cfm, 8 psi.
1—#70 Buffalo paddle wheel Blower.
11—Hydraulic Pumps, Water & Oil
26—Spencer Turbines 35-4000 CFM.
33—Asstd Engine dr. Pumps & MG Sets.
70—Various Port & Stat. Agitators.

SUPERIOR EQUIPMENT CO.
136 GRAND ST., N. Y. C. CAnal 6-6983-4

FOR SALE

One 750 KW
Motor Generator Set
ALLIS CHALMERS
3000 Amps • 720 R.P.M.
Full Load 250 Volts DC

AC Motor • Allis Chalmers
3 Phase — 60 Cycles
208-220 Volts — 2840 Amps
720 R.P.M.
With Starting Equipment

Can be seen in our warehouse located at 53rd St. and First Ave., Brooklyn, N. Y.

HEARN DEPARTMENT STORES, INC.
MARK M. TROSTLER, *Pur. Agent*
74 FIFTH AVE., NEW YORK, N.Y.

WE HAVE FOR SALE

4—General Electric Motor Generator Sets, each 60 volt, 1500 ampere D. C. mounted on a common iron base and coupled to 3 phase, 60 cycle, 220 volt A. C. motors.

2—D. C. Control Panels.

4—A. C. Magnetic Starters.

These sets can be seen in operation at the Plaza Hotel, New York City. They are now running two in series totaling 240 volts each set. They are practically new.

Price for total equipment, $14,000.00

ALBERT MURRELL
BUILDING SUPERINTENDENT — PLAZA HOTEL
2 West 59th Street PLaza 9-3000 New York 19, N. Y.

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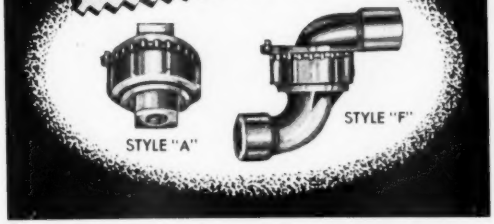

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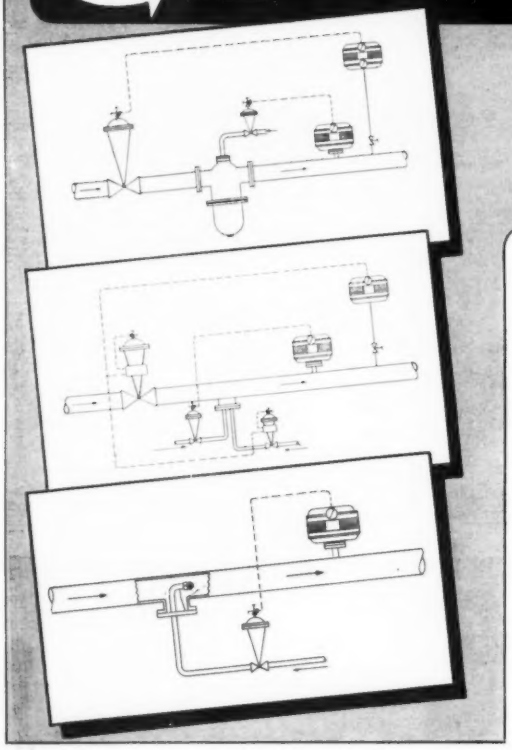

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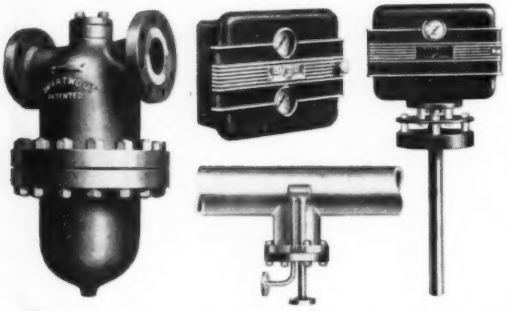

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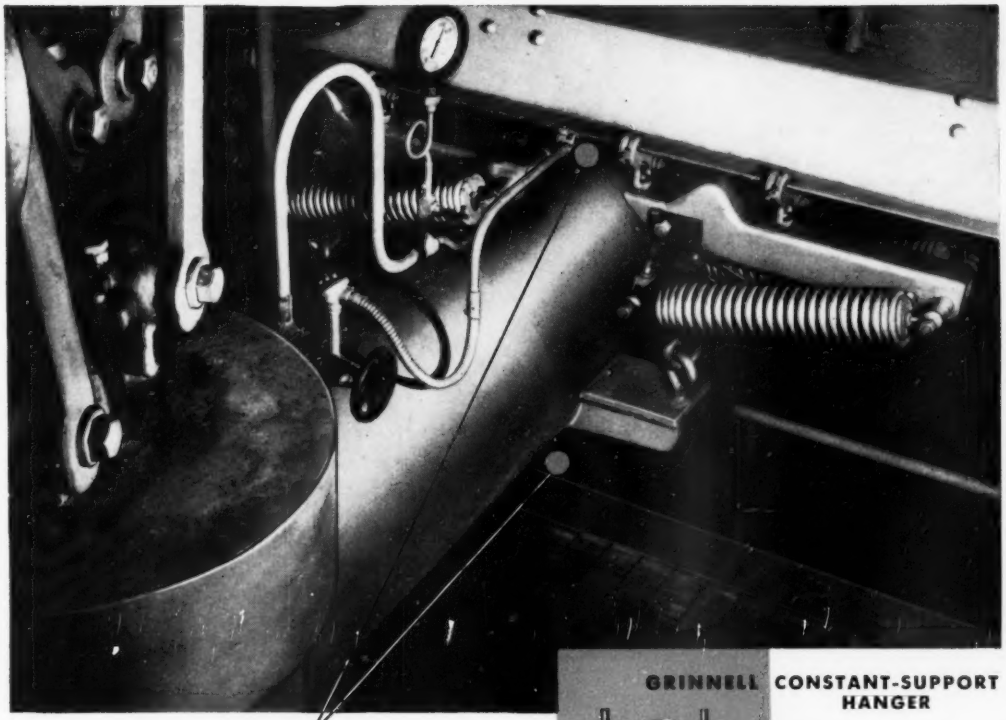

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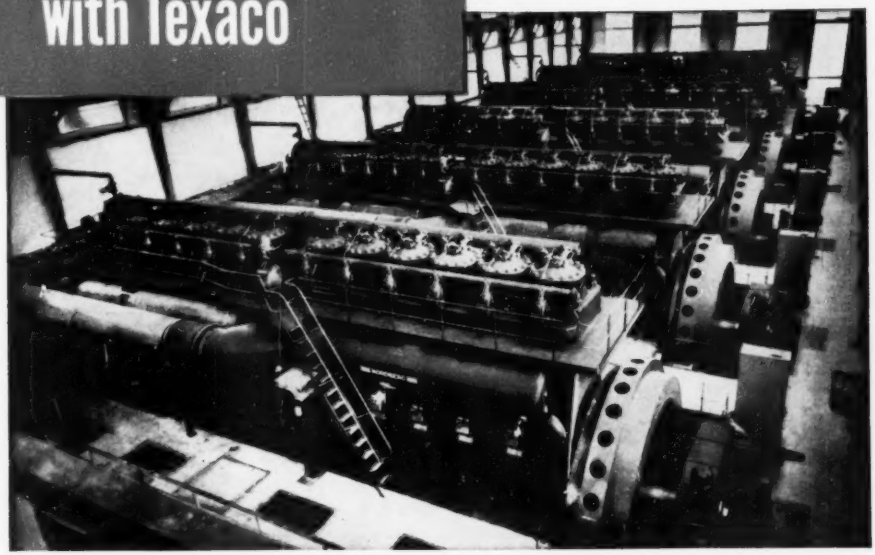

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